

a handbook on

# RABBIT RAISING

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CALIFORNIA AGRICULTURAL EXTENSION SERVICE  
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# *In Rabbit Raising*

The sources of income are → sale of meat, pelts and furs, wool, and breeding stock.

The points of management are → raising enough animals to furnish a livelihood above the costs of labor and materials; obtaining high efficiency in management; keeping production costs as low as efficient management will permit; offering a high-grade product; and having a satisfactory source of distribution and marketing.

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# A HANDBOOK ON RABBIT RAISING

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RABBIT RAISING can be a successful enterprise if climate is favorable and marketing facilities are dependable. In general it has furnished only a modest livelihood,

and the present condition of the market does not predict large returns from any one of the four sources of income—meat, pelts and furs, wool, or breeding stock.

## RISKS FOR THE BEGINNER

There is financial risk for the beginning operator who knows nothing about the industry. Rabbit raising is passing from a side-line enterprise to a principal source of income, with methods of large-scale marketing only partially worked out. A beginner therefore cannot feel so confident at entering this field as he would poultry production or any other established branch of agriculture.

**Booms.** There are also some hazards which are especially the beginner's. Rabbit booms are one. The Belgian Hare craze of many years ago is an example; another boom met the need for additional meat during World War II. Sudden and abnormal increases in rabbit production may mean financial loss to a beginner. A ready market cannot always be found for the products at prices allowing a fair rate of interest on the high cost of breed-

ing stock. Only an established breeder can cope with such problems during a boom period.

**Unsound Investments.** In these ventures a promoter offers real estate or fur breeding stock at fancy prices. Too often the promoter is concerned only with the sale of land or the disposal of breeding stock. One such scheme is called the "buy-back" contract. A promoter offers to supply breeding stock and suggests that, in return, he will purchase the stock produced. Usually he approaches a prospective operator with the promise of profits greatly exceeding the average. This scheme is particularly unsafe in that few of the contracts can be legally enforced. If a concern offers a buy-back contract, demand the names of financial supporters and be suspicious of any refusal to furnish such information.

## THREE GROUPS RAISE RABBITS

In spite of these problems, California favors the industry through a mild climate and especially through consumer interest which is growing as the program of distribution and marketing develops. Well over 30 million pounds of live rabbits are sold annually in the state. The Los Angeles area alone consumes between 14 and 16 million pounds of rabbit meat yearly. Of the 20 million rabbits produced or on hand in the United States in 1947, the United States Rabbit Experiment Station

at Fontana, California, reports that about one third was raised in southern California.

If a beginner is aware of these problems, he can then turn his attention to many questions about the field: Who raises rabbits; what are the sources of income; what is the labor requirement; how is a rabbitry built and operated; what are the different breeds; how are rabbits fed and cared for; what diseases and parasites attack them; how are rab-

bit products prepared and marketed; what are the costs involved and the returns expected; and what is a standard of efficiency?

**The home operator** has merely enough animals to supply his own requirements. Information about housing, feeding, general care, treatment of disease, and control of parasites is of particular interest to him. Distribution and marketing are of no concern unless his total costs are more than retail costs.

**The part-time operator** raises rabbits in addition to holding an outside job.

He is concerned with the information needed by the home operator and, in addition, information about the time necessary for operation and the most convenient channels of sale. Efficient production and a steady market are highly important.

**The full-time commercial operator**, whose main source of income is production for the market, is concerned with housing, breeding, feeding, care, treatment of disease, control of parasites, preparation for market and marketing, and business management.

## SOURCES OF INCOME

Meat, pelts and furs, wool, and breeding stock comprise the main sources of income. The amount of income varies with the type of enterprise, and choice of enterprise depends on local demands. The relative importance of the different sources was almost unknown until supervised records of rabbitries became available through two studies of the industry in southern California, conducted by the Agricultural Extension Service of

the University of California. One was the Enterprise-Management studies for the period 1930-1939, for several counties in southern California, which represent more than 100 yearly records on some 7,000 breeding does. The other was the Southern California Rabbit Management studies for 1947 and 1948. The latter studies furnish the most recent figures on costs and returns used in this circular.

## Meat

Rabbit meat has all the qualifications of a high-grade meat. Tests made by the United States Department of Agriculture show that it compares favorably with other meats as a source of protein (table 1). The meat of young fryer rabbits usually contains less fat than mature beef.

Its relative protein value compared with beef when tested at the United States

Rabbit Experiment Station at Fontana was found to be 93 per cent digestible, with no significant difference in comparison with beef. Its tenderness by cooking was tested by the United States Bureau of Home Economics. A rabbit cooked 1 hour and 15 minutes was found to be more tender than a chicken cooked 2 hours and 30 minutes.

Table 1. COMPARATIVE COMPOSITION OF RABBIT MEAT AND BEEF\*

Kind of meat	Percentage dry matter	Percentage protein (N. x 6.25)	Percentage fat (ether extract)	Percentage minerals	Calories per gram
Rabbit.....	40.2	30.8	7.0	1.6	200
Beef.....	42.4	30.3	10.8	1.3	220

\* Tests reported by Dorothy B. Darling and Hugo W. Nilson of the Fish and Wildlife Service, United States Department of the Interior.

Since rabbit meat furnishes a high-grade protein, its future production depends very largely on demand. If demand is to remain dependable or to increase, the meat must be readily available in appetizing form and at economical prices.

An efficient operator should be able to average more than 5 marketable rabbits to the litter. Records of the rabbitries co-

operating in the 1947 Southern California Rabbit Management Study indicate that the average number of rabbits raised per doe was 22.1, or better than 5.7 rabbits raised per litter at 3.8 litters per doe a year.

The costs and returns on rabbit meat are discussed under "Business Aspects," on page 56.

### Pelts and Furs

Although the terms "pelts" and "furs" are often used interchangeably in statistical reports of the industry, rabbit pelts ordinarily consist of butcher-run and hatters' pelts. Butcher-run is the term used for the pelts skinned from rabbits raised for meat; their quality varies according to breed and to treatment after skinning. Hatters' pelts comprise the least desirable of all pelts. Rabbit furs, on the other hand, usually indicate the fine-quality fur pelts from animals especially bred for their fur.

**Pelts.** Under normal conditions, the United States imports a large number of rabbit pelts, chiefly from Australia, New Zealand, France, Belgium, and England (table 2). Imports make up possibly 98 per cent of the pelts used in this country. During 1936 to 1939, inclusive, almost 19 million pounds of undressed rabbit pelts were imported at a yearly value of

\$13,965,800. Imports for 1945 to 1948, inclusive, averaged about 22 million pounds, valued at more than \$24,000,000. In addition, more than 3½ million undressed hare pelts were annually imported in the 1945 to 1947 period at a value of more than \$6,000,000 a year. Undressed rabbit pelts are admitted into the United States duty free.

These figures have given the impression that the average rabbit raiser has a bright outlook in the sale of rabbit pelts to meet the great demand. This is not true. The California Enterprise-Management studies show that a very small percentage of the total income in rabbit raising is from pelts—averaging about 50 cents per breeding doe (see "Business Aspects," p. 56). Only rarely has the individual rabbit raiser exceeded this amount.

It is often impractical for a producer

**Table 2. IMPORTS OF UNDRESSED RABBIT AND CONEY AND HARE PELTS FOR THE YEARS 1935 AND 1936, AND 1945 TO 1948, INCLUSIVE**

Year	Rabbit and coney pelts (undressed)		Hare pelts (undressed)	
	(dollars)	(pounds)	(dollars)	(pounds)
1935*	\$13,973,303	32,291,879	\$ 775,736	2,519,834
1936.....	20,921,056	21,392,369†	1,329,959	8,686,378
1945‡.....	19,477,878	21,169,812	3,392,737	2,242,426
1946.....	33,295,651	26,442,642	5,502,655	3,013,740
1947.....	21,614,506	19,406,013	9,766,428	5,688,832
1948.....	22,747,009	23,720,924	3,409,878	7,020,099

\* Years 1935 and 1936 from Foreign and Domestic Report of United States Department of Commerce.

† Weight estimated on basis of 128,354,214 pelts.

‡ Years 1945 to 1948 from report No. Ft. 110, General Imports of Merchandise, United States Department of Commerce.

of meat rabbits to keep the pelts—for instance, if he is a large producer who sells rabbits alive to be dressed in central killing plants in the larger cities. The small side-line operator who markets direct, however, can easily handle the pelts; in fact, the pelt income, no matter how small, is important to his management program.

Domestic producers need to know approximately what per cent of the American demand for pelts can be supplied by the domestic industry. Presumably they have a long way to go before they can meet this demand. Still more important is the question of whether or not they can equal the quality of the best imported pelts and still show a profit. All points therefore indicate that the income from pelts should not be ignored by the beginner, but that it should not be overestimated.

**Furs.** In fine rabbit-fur production, California supplies some of the best furs received on eastern markets. To achieve this, however, special attention has been given to breeding, which may influence fur quality more than feeding or climate. Certain light-weight breeds, such as the Chinchilla and the Castor Rex or its crosses, have been developed to meet this need. Operators who have specialized in the breeding and proper handling of high-quality furs are receiving prices well above the average.

Each prospective fur producer should study the markets in relation to his own abilities before estimating possible income from the sale of furs. It is definitely not a field for the beginning operator, and even the experienced operator should realize that the operation of a rabbitry for pelt or fur production alone is not practical except by special breeding.

## Wool

A survey made by the American Angora Rabbit Breeders' Association indicates that California leads all other states in the raising of Angora wool rabbits. This increased interest in the production of rabbit wool may be traced to certain advertising which emphasizes the possi-

bility of high returns. Here and there some breeders may secure high returns from Angora wool, but the prospective operator needs to look into this field very carefully before entering it.

Table 8, which appears in "Business Aspects," on page 59, presents a general

Table 3. U. S. ANGORA RABBIT WOOL IMPORTS FOR CONSUMPTION, 1948\*

Country	Pounds, scoured	Value, dollars	Pounds, greasy	Value, dollars	Pounds, washed	Value, dollars	Pounds, sorted	Value, dollars
Canada.....	6,502	34,371	78	447	80	405	75	100
Mexico.....	12,907	73,243	..	....	1,428	9,500	205	574
Denmark...	711	4,971	..	....	....	....	....	....
United Kingdom.....	.....	.....	..	....	301	1,204	....	....
France.....	27,022	214,593	..	....	8,141	73,715	....	....
Italy.....	73,980	424,108	..	....	2,565	9,265	441	2,600
Austria.....	575	2,884	..	....	....	....	....	....
Totals.....	121,697	754,150	78	447	12,515	94,089	721	3,274

\* The total of imported pounds was materially larger in 1948 than in 1947. Japan shipped some in 1947 but none in 1948. Italy, France, Mexico, and Canada continued to supply the bulk of Angora rabbit wool imports.

summary of wool rabbit records over the three-year period 1937–1939 in the Enterprise-Management studies in Los Angeles County. An average of 678 breeding does failed to show high profits either for the wool or for the rabbitry as a whole.

Yields of wool depend on the strain and the care of the individual animal. Breeders speak of 8-ounce woolers and 16-ounce woolers, meaning rabbits producing that many ounces in a year. An average of 1 pound of wool a year is a possibility being reached by efficient producers, but 12 to 14 ounces for a mature rabbit are very likely well above the average in most rabbitries.

More accurate records are necessary to show what can be expected in the specialization of Angora wool. Any increase in its production should be accompanied by

market development. A limited number of animals may be sold for breeding, but the most important problem is to find a market for the wool or yarn at prices notwithstanding competition of imported rabbit wool. The import of Angora rabbit wool quickly affects prices on the American market. The imports for American consumption in 1947 are shown in table 3.

The figures in table 8 on page 59 clearly indicate that income from wool alone may not be sufficient to cover cost of production, even though all records available indicate that Angoras show a lower feed cost and lower average hours of labor per doe than any other breed. If you are going to raise Angora wool rabbits, capitalize on all outlets of sale—meat, breeding stock, and wool.

## Breeding Stock

For many years rabbit raisers with established reputations for dependable breeding stock have secured a good income. In exceptional cases, breeding stock made up about 70 per cent of the sales; but, judging from sales reported during the past ten years (see "Business Aspects," p. 56), the average rabbit raiser

has secured only a small percentage of his total income from breeding stock.

The beginner who has not yet established a reputation for producing good breeding stock, and others who do not attempt to keep purebred animals, will probably not realize very much from such sales.

## Miscellaneous Sources

There are very few additional sources of income in rabbit raising. The most important is sale of manure as fertilizer (see "Business Aspects," p. 56). A few animals are sold to experimental laboratories and to biological laboratories where

they will be used in tests for pregnancy.

Rabbits are also sold as pets, a practice frowned on by most commercial rabbit producers who consider the sentiment associated with rabbits one of the greatest drawbacks to the sale of rabbit meat.

## FANCY STOCK FOR EXHIBITION

If a rabbit raiser wants to combine fancy stock with utility, he needs to know something about the care and management of fancy stock. Special publications on the exhibition of rabbits at shows have been published; these can be secured from some of the public libraries or bought direct from the publishers.

**Choosing the Breed.** A good utility rabbit fit for meat and high-quality fur may also be a good fancy rabbit. There may be some difference between the two standards; yet, in a general way, there is close agreement. The best purebred rabbit can be made to adhere very closely to the fancy standard and, at the same time,

meet all normal requirements for meat, fur, or, with Angoras, wool. If a rabbit is not a purebred, even though it is capable of meeting the demand for meat, fur, or wool, it is excluded from sale as a fancy breeder, or from receiving prizes and exhibition publicity.

Many rabbit raisers prefer to start with animals eligible for registry and meeting the standard either for utility or fancy stock. There is some ground for selecting the pedigree rabbit even for utility purposes. It takes several generations of systematic breeding to meet the normal standard. The young of pedigree rabbits are usually uniform in weight, time of maturity, color of fur, and other factors which are of vital interest to the utility rabbit breeder.

Fancy rabbits need about the same care as ordinary utility rabbits. In addition they require special attention to fit them for exhibit. Disqualifications that in no way interfere with sale for utility purposes must be overcome for the show. Even the smallest disqualifications cannot be overlooked. If a rabbit is not near maximum age at the time of the show, it stands a very poor chance of winning unless it is exceptionally strong in such points as color and shape. Nurse does are sometimes used to assist in securing maximum size for age when young rabbits are to be exhibited.

It is a good practice to visit rabbit shows and become more or less familiar with the methods usually followed in judging. These shows are of great educational value to both rabbit fanciers and utility breeders. They call for organization among producers, and the contact between members and the public helps to

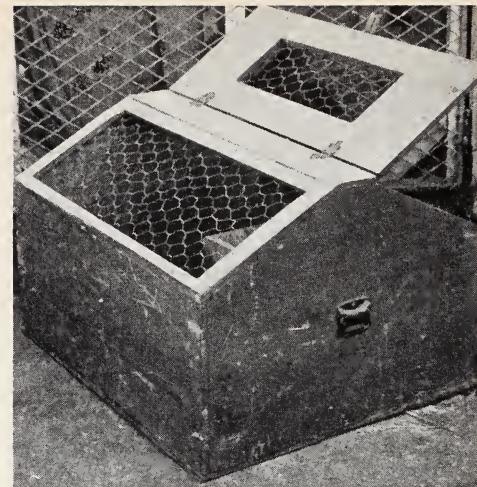


Fig. 1. Single-compartment shipping box, 18" × 22" (14" high at center, 8" at sides).

increase production and sale of rabbits and rabbit products.

**Carriers.** Fancy rabbits and rabbits sold as breeders are shipped in the type of carrier shown in figure 1. Packages cannot be easily stacked on this type of case, so the animals are assured plenty of air. If the owner is exhibiting only one rabbit and plans to carry it, he may prefer a lighter carrier with a hand grip on top.

The carrier must be well ventilated, and should be cleaned regularly to help prevent such diseases as coccidiosis. Place only one rabbit in a compartment; two may fight and injure each other. Carriers must be of ample size, and should be bedded with straw to keep the fur coat from being soiled. A little feed may be enclosed if necessary. Where a breeder takes his animals to the show by automobile, feed and water will seldom be necessary en route.

## HOURS OF LABOR REQUIRED

The minimum time required to operate a rabbitry is approximately 12 to 14 hours annually per doe, although the more profitable group of larger rabbit operators averaged 10 hours. Hours of labor required have decreased, according to the

Southern California Rabbit Management studies. It was found that, with an average of 110 breeding does per rabbitry, the average number of hours of labor required per doe was 17.0 for 1945, 13.2 for 1947, and 13.5 for 1948. An operator

working on this schedule could therefore care for approximately 250 breeding does yearly by working an average of 8 hours a day.

Increased efficiency in the use of labor has not been sufficient to overcome the increased hourly cost (see "Business Aspects," p. 56).

## CLIMATE

A mild climate in most parts of California is an important factor in the growth of the rabbit industry. Rainfall, which is not heavy, is limited almost entirely to the period between November and April.

The outdoor hutch is satisfactory in almost all districts. In the hot inland val-

leys, heat is a problem, although not one of the more serious, since the United States Rabbit Experiment Station has located in a part of the state where summer temperatures occasionally run high. In such areas special protection is needed. In a cool climate, also, the outdoor hutch will need some protection (p. 13).

## CONSTRUCTING THE RABBITRY

### The Hutch

Build the hutch for convenience and permanence. A well-built hutch is economical to operate and easy to keep sanitary. Dark hutches which leak and are cold and drafty will cause the breeder serious trouble. He will not be able to raise his stock successfully nor to sell it to advantage.

Sunlight and fresh air must reach the inside of all hutches, especially those in which young rabbits are developing. Rabbits raised in clean, sunny, well-ventilated hutches are seldom affected with respiratory diseases.

Hutches must be kept clean and dry at all times. This is vitally important. Protect them from rain, and protect each tier from any leaks in the hutches immediately above. If this is not done, diseases will appear.

Most of the standard types have been tested at the College of Agriculture at Davis, and the one found to give the best results is shown in figure 2. This hutch has been efficient and economical under all ordinary conditions found in California. Each compartment measures 4 feet long by 2.5 feet deep by 1.5 feet high. Plans for this hutch are given in figure 3.

Commercial hutches may be built 2 or 3 tiers high—that is, 2 or 3 compartments built one on top of the other. The height

should be regulated by the height of the caretaker. If the floor of the bottom hutch is within 6 or 8 inches of the ground, a man of medium height will have no difficulty in reaching the top of a 3-tier hutch. A youth or a short woman, however, may find the 3-tier hutch too high (see fig. 2), yet be able to reach a 2-tier hutch without any difficulty. Some producers say that roomy, single-tiered hutches are the easiest to keep sanitary. If land is not too costly the slightly greater expense of single-tiered hutches may be more than offset by the reduced amount of maintenance.

**Floors.** The so-called self-cleaning floor is in approximately 98 per cent of the rabbitries in southern California, and is popular everywhere. It is usually made of  $\frac{5}{8}$ -inch hardware cloth—also called fruit-drying cloth. This type of floor not only reduces the hours of man labor per doe per year but also makes the control of disease easier.

A slatted floor is very hard to keep clean. A solid floor with hardware cloth-covered toilet in the back (fig. 2) is partially self-cleaning. This floor is satisfactory only when kept clean and dry. Smooth perforated metal has been tested at the United States Rabbit Experiment Station with good results, but it is rarely

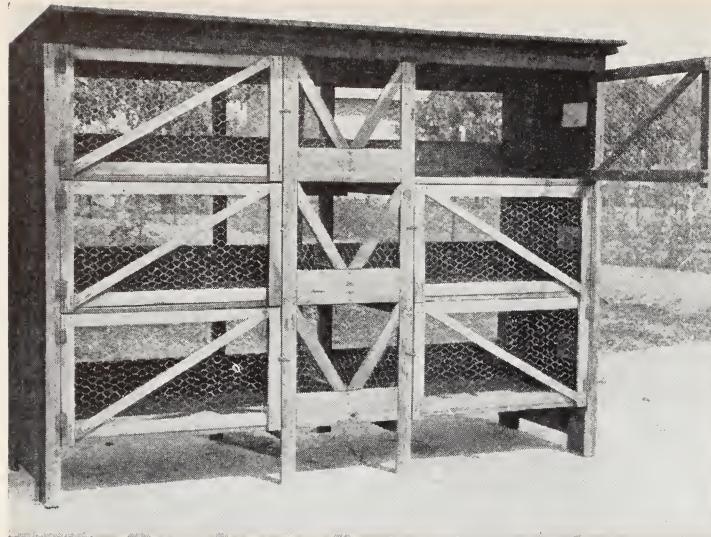
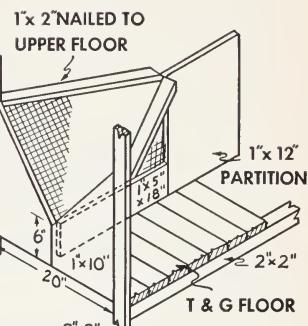
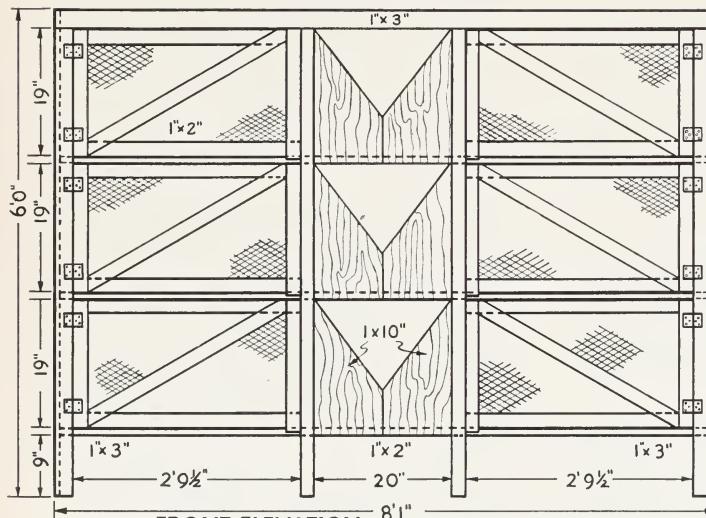


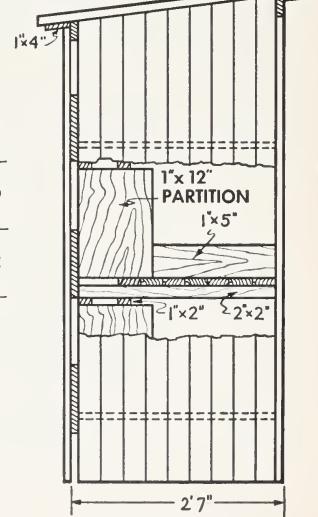
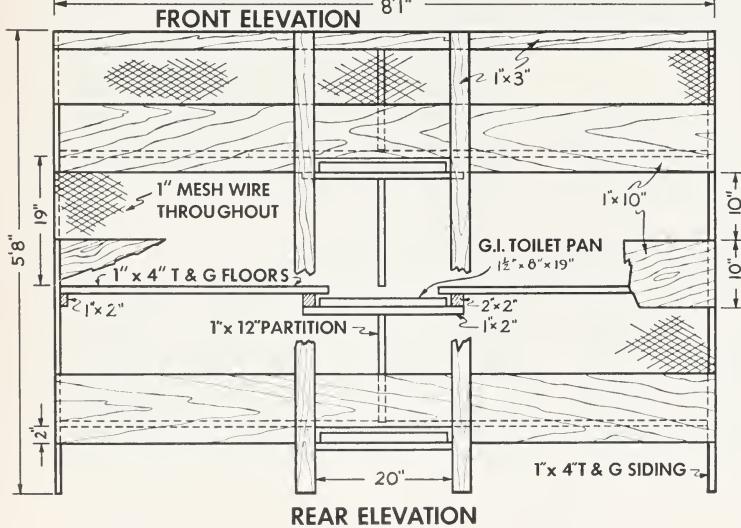
Fig. 2. Recommended 3-tier hutch.  
Note braced doors that close over floor.

**ROOF NOT SHOWN**



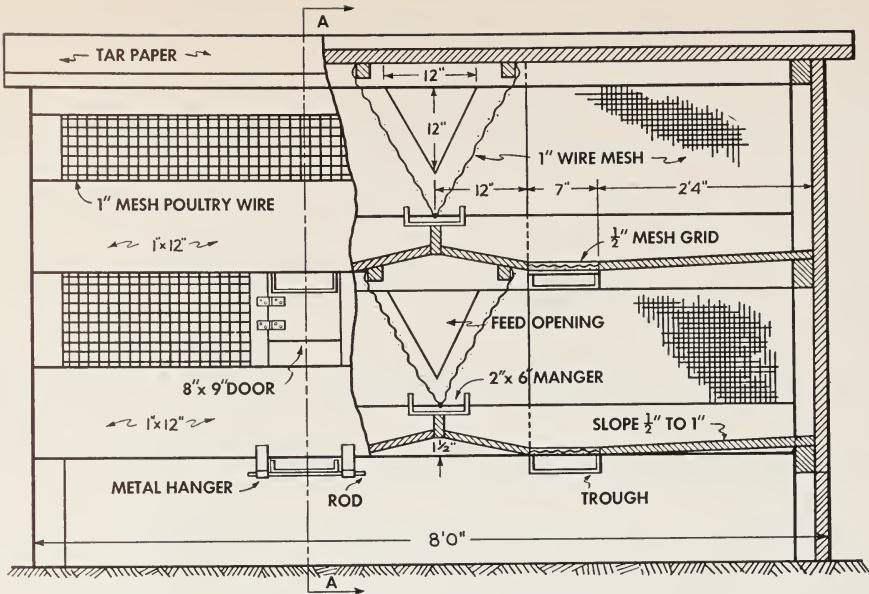
**FEED HOPPER**

1" x 4" T & G ROOF



**REAR ELEVATION**

**END ELEVATION**



REAR ELEVATION AND, RIGHT, CROSS SECTION

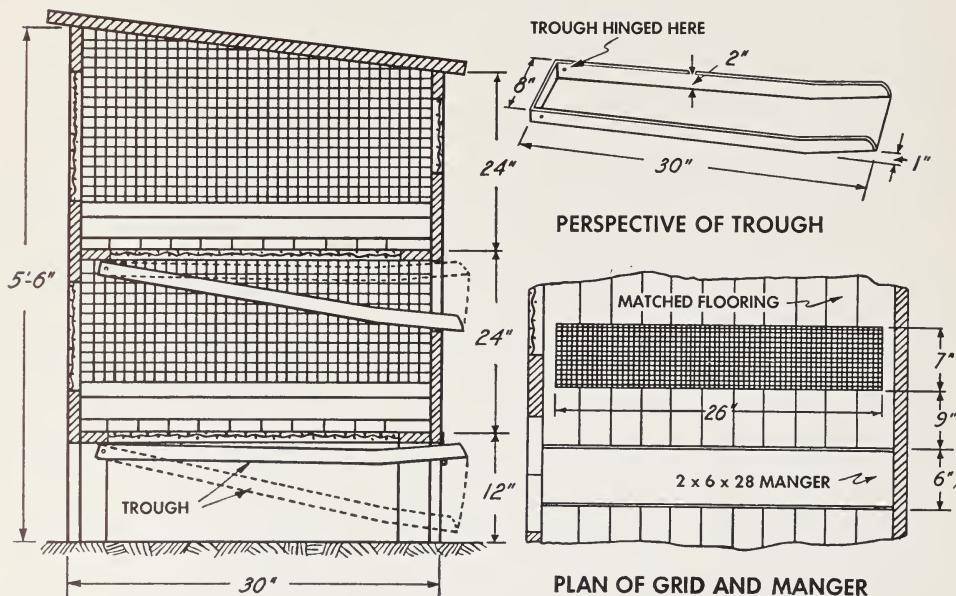


Fig. 3. Page 10: Plans for a 3-tier, 6-compartment hutch. Fig. 3A, above: The V-shaped feeder with trough beneath (upper rear elevation) is used in many California rabbitries. A toilet pan runs crosswise through the hutch compartment and is set back from the feeder. The trough beneath makes cleaning easy. (Courtesy of A. M. Newbegin, who designed the equipment here shown.)

## SPECIFICATIONS AND LIST OF MATERIAL FOR A 3-TIER RABBIT HUTCH

Lumber (pieces)	Size	Kind of lumber	Place
27	1" × 4" × 8'	T&G Douglas fir (Oregon pine)*	Floors; 9 pieces for each floor.
15	1" × 4" × 7'	T&G Douglas fir (Oregon pine)	Roof. Cut to 30 pieces 1" × 4" × 3'6".
18	1" × 4" × 6'	T&G Douglas fir (Oregon pine)	Ends; 9 pieces for each end.
2	1" × 4" × 8'	Douglas fir (Oregon pine)	Roof cleats or strips.
1	1" × 10" × 18'	Douglas fir (Oregon pine)	Backs for two floors. Cut to 2 pieces 1" × 10" × 8'2".
1	1" × 10" × 10'	Douglas fir (Oregon pine)	Back for third floor. Cut to 1 piece 1" × 10" × 8'2".
1	1" × 10" × 10'	Douglas fir (Oregon pine)	Fronts of feed racks. Cut to 2 pieces 1" × 10" × 5'.
1	1" × 3" × 12'	Douglas fir (Oregon pine)	Back uprights. Cut to 2 pieces 1" × 3" × 5'6".
1	1" × 3" × 12'	Douglas fir (Oregon pine)	Front uprights. Cut to 2 pieces 1" × 3" × 5'8½".
1	1" × 3" × 18'	Douglas fir (Oregon pine)	Front and back top rails. Cut to 2 pieces 1" × 3" × 8'2".
1	1" × 3" × 12'	Douglas fir (Oregon pine)	Bottom slats for toilet pans. Cut to 6 pieces 1" × 3" × 2'.
1	1" × 12" × 6'	Douglas fir (Oregon pine)	Back partitions. Cut to 3 pieces 1" × 12" × 1'7".
1	1" × 5" × 6'	Douglas fir (Oregon pine)	Front of partitions under feed racks. Cut to 3 pieces 1" × 5" × 1'6½".
3	1" × 2" × 10'	Douglas fir (Oregon pine)	Floor joists. Cut to 12 pieces 1" × 2" × 2'6".†
1	1" × 2" × 12'	Douglas fir (Oregon pine)	Strips for top of feed racks. Cut to 6 pieces 1" × 2" × 1'10".
3	1" × 2" × 18'	Douglas fir (Oregon pine)	Doors. For top and bottom rails cut 12 pieces 1" × 2" × 2'9½" and 6 pieces 1" × 2" × 3', for braces.
1	1" × 2" × 20'	Douglas fir (Oregon pine)	End rails of doors. Cut to 12 pieces 1" × 2" × 1'7".

\* Douglas fir (Oregon pine) has been mentioned in the list of materials but other available lumber of suitable grade may be substituted. Soft wood is not suitable.

† Plans in figure 3 call for 2" × 2" floor joists in the center of the hutch, but 1" × 2" pieces will usually be strong enough.

## Hardware

6 pairs	2" tight butts or 3" strap hinges	Doors, two hinges for each door.
6	2" turn buttons	Doors, one for each door.
24 feet	1" mesh 12" wide poultry netting, galvanized after weaving	Hutch backs. Cut into 3 pieces 1' × 8'.
21½ feet	1" mesh 18" wide poultry netting, galvanized after weaving	Doors and feed racks. Cut 6 pieces for the doors, each 18" × 33". Cut 3 pieces for the feed racks, each 18" × 20".
20 inches	5/8" mesh 24" wide hardware or fruit-drying cloth‡	Toilets. Cut into 3 pieces, each 8" × 20".
3	1½" × 8" × 19" galvanized droppings trays	One for each toilet opening.
3 pounds	8d box nails, cement coated	

available. Unless local conditions require some other material, most rabbit raisers will find the standard galvanized hardware cloth of  $\frac{5}{8}$ -inch mesh most satisfactory. If this is not available, substitute 1-inch-square wooden slats, spaced no more than  $\frac{5}{8}$  inch apart, but keep the floor as dry and clean as possible. If a floor has a rough surface, place a slatted stand or flat board at one end where the rabbit may rest. This will help to prevent hock injury (see p. 48).

**Toilets.** If a solid floor is laid, plan for a toilet pan in each hutch. Place the toilet opening at the rear, away from the hay and the nest. In a single-compartment hutch, when the floor is laid, leave an opening 8 inches deep by 19 inches wide at the back near one side wall; in a double compartment hutch extend the toilet opening into the adjoining compartment floor for 19 inches. This 38-inch wide opening will accommodate the 2 adjoining toilets. On the underside of the hutch floor surrounding the opening, tack hardware cloth or heavy galvanized wire netting with a mesh not larger than  $\frac{5}{8}$  inch. Beneath the opening, set a galvanized-

iron pan which can be slipped in through an opening at the rear of the hutch. A larger pan can be used to cover the space occupied by the toilets in two adjoining compartments. Another type of toilet is shown in figure 3A.

Where a single hutch stands over a concrete floor, no pan is needed beneath the toilet opening, but clean the concrete floor beneath regularly.

**Walls.** Figure 2 shows that only the two opposite ends of the hutch are boarded solid. The door in front and the back wall are covered with wire netting. In a cool climate, however, place a 10-inch board at the back to give some protection or, if necessary, board in the back solid.

**Roofs.** Build the roof solid on all hutches—single, 2 tier, or 3 tier. Set the roof boards to form a 6- to 8-inch overhang in front and slope them downward to a 2-inch overhang at the rear. Cover the board roof with rainproof roofing material to make the hutch leakproof.

**Doors.** The hutch door should extend the full length of the hutch except where a narrow alleyway in front of the hutch

‡ If metal is not available, wood should be substituted and the wooden slats spaced  $\frac{5}{8}$  inch apart. If drawer feeders are used, allow one drawer of about 3" × 8" × 18" for each double compartment and face front edge of drawer with tin.

prevents the door from swinging outward. Fit the outer-end cleats of the door snugly over the edge of the flooring at the bottom to act as door stops (figures 2 and 3). A door hung in this way is not easily clogged with hay or litter.

There is no special advantage in having a separate door in front of the nest. Odd-shaped doors are costly and unnecessary. Rectangular-shaped doors are the easiest to construct. They can be used with the V-shaped feeder if the space under the feeder is boarded up straight and solid. Where only pellets are fed, the door can overlap the partition between two adjoining hutch compartments. By opening only one door, feed can be placed in two compartments.

Equip each door with strong hinges and easily closed catches. Cover the inside of all doors with 1-inch-mesh galvanized-wire netting. In normal times, wire netting is cheap, durable, and easily available. It cannot be spread or gnawed by the rabbits, and protects the wooden frame when placed on the inside of the door.

**Costs and Specifications.** Lumber and labor costs vary too much for the cost of a hutch to be estimated except in a general way (see "Business Aspects," p. 56).

The list of building materials on pages 16 and 17 can be used for the hutch shown in figure 2. Any lumberyard can furnish cost estimates on the materials listed or suggest substitutes for unavailable ones.

## The Rabbit House

Large rabbitries sometimes place the hutches in a house. If a house is planned, build it large enough to hold all the hutches and to accommodate a storage unit for quantity amounts of feed.

Concrete is used for the floor of the house, with drains provided to carry off the water quickly during hosing-out. Glass or glass substitutes are seldom necessary in California for rabbit houses. This is fortunate because ordinary glass excludes the ultraviolet rays of the sun, and there is doubt about the amount of ultraviolet rays admitted by glass substitutes. Glass substitutes have not always been durable, and most types need sub-

stantial frames to prevent sagging, which necessitates additional cost.

Plan the house so that sunlight reaches every hutch at least part of the day (figures 4 and 5). Face the house south. If the hutches are placed crosswise, leave a space of at least 4 or 5 feet between hutches to admit sunlight; if the hutches stand lengthwise, place them out far enough from the rear wall to permit removal of the toilet pans. Leave plenty of aisle room in which to open hutch doors, carry feed, and clean.

If a separate compartment for feed is planned at the end of the house, make it rat- and mice-proof, and protect it from dogs and cats.

## Lath Shelters

The essential shade in hot climates can be provided by a lath shelter. A properly constructed shelter tends to reduce wind velocity and to lower the temperature. Where the heat is very intense, a solid roof is sometimes laid to accommodate a sprinkling system. However, a solid roof tends to exclude winter sunlight. Burlap sacks hung from the eaves of a lath roof and kept wet will furnish as effective a cooling system for hutches as will

the installation of roof sprinklers.

The shelter roof is usually supported by 7- or 8-foot posts. The roof laths should be thicker and much longer than ordinary plaster lath which can be used for the sides. Most operators agree that the spacing between laths should be considerably less than the width of a lath. This provides shade, yet permits entrance of enough direct sunlight. Lath shelters are usually of permanent construction.



Fig. 4. Interior of a modern rabbitry, showing arrangement of one-tier hutches to insure adequate sanitation and ease of feeding.

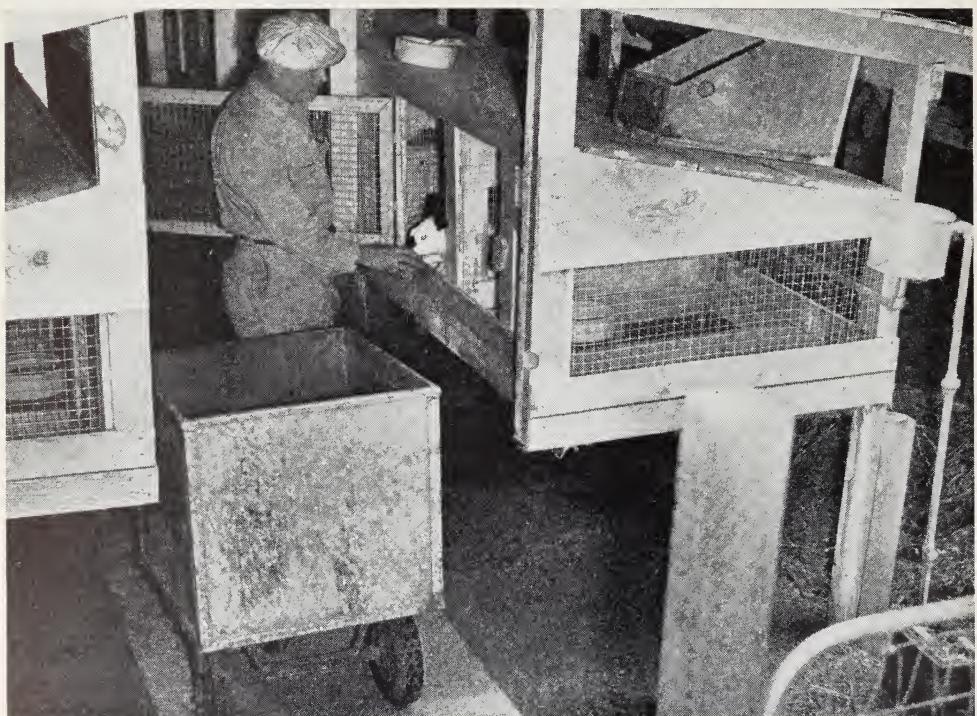


Fig. 5. Cleaning and feeding operations in this commercial rabbitry may be carried out with minimum labor. An adequate water supply is easily available.

## Runways

Runways or developing pens may be used in good weather for growing rabbits. Plans for one of these knock-down outdoor rabbit runs are shown in figure 6. The runways may be 5 feet wide by 6 feet long by approximately 2½ feet high. Their framework is wood, covered with 1-inch-mesh wire netting. Allow about 8 to 12 weaned rabbits to each compart-

ment of the type of rearing pen shown in figure 6, or 1 rabbit to each 2½ square feet of floor space. The 5/8-inch wire-netting floor used in this pen enables the rabbits to eat the feed and, at the same time, prevents them from digging out.

The construction of these runways permits their being moved about over growing green feed.

### MATERIALS AND SPECIFICATIONS FOR A 2-COMPARTMENT RABBIT REARING PEN

Lumber (pieces)	Size	Kind of lumber	Place
4	1" x 4" x 12'	Douglas fir (Oregon pine) or redwood	Top and bottom side rail, 2 for top rails and 2 for bot- tom rails.
5	1" x 4" x 10'	Douglas fir (Oregon pine) or redwood	Cut 4 pieces 1" x 4" x 2½' for end rails; 2 pieces 1" x 4" x 2½' for center rails at sides; 4 pieces 1" x 4" x 5' for top and bottom rails across ends; 2 pieces 1" x 4" x 4'9" for top and bot- tom rails of partition; and 1 piece 1" x 4" x 5' for center cross piece at top.
5	1" x 3" x 10'	Douglas fir (Oregon pine) or redwood	Cut 2 pieces 1" x 3" x 4'7", one for each feeder top rail; 4 pieces 1" x 3" x 5' for 2 cross rails for each door; 4 pieces 1" x 3" x 4'9" for 2 side rails for each door.
2	2" x 2" x 10'	Douglas fir (Oregon pine) or redwood	Cut 4 pieces 2" x 2" x 2½', end rails, one for each cor- ner; 4 pieces 2" x 2" x 12", fillers for ends of feeders; 2 pieces 2" x 2" x 2½', for end rails of partition.
1	1" x 12" x 4'	Douglas fir (Oregon pine) or redwood	Cut into 2 pieces 1" x 12" x 2' and then saw diagonally to make 4 ends of feeders.

## Hardware

2 pounds	8d box nails, cement coated	
2 pairs	strap hinges, galvanized	One pair for each door.
12	$\frac{1}{4}$ " $\times$ 3" wing machine bolts (square heads)	Two for each corner support and two for each side at center.
39 feet	1" mesh 2' wide hexagonal poultry netting, galvanized after weaving	Cut 2 pieces 5' $\times$ 2', one for each end; 2 pieces 12' $\times$ 2', one for each side; 1 piece 5' $\times$ 2' for the partition.
5 feet	1½" mesh 5' wide hexagonal poultry netting	Cut 2 pieces 5' $\times$ 2½', one for each feeder.
12 feet	1½" mesh 5' wide hexagonal poultry netting	For bottom.
10 feet	2" mesh 5' wide hexagonal poultry netting	For top.

## ARRANGEMENT OF HUTCH EQUIPMENT

**Feed and Water Containers.** A well-arranged rabbitry requires a minimum amount of labor. The arrangement of feed and watering equipment is shown in figure 5. Automatic water systems, such as the "dewdrop," may replace water dishes. If hay is fed, a V-shaped central feeder is considered the best. It is not used if pellets only are fed. Grain and water are placed in earthenware dishes or in specially constructed galvanized-iron feeders or in self-feeders. Door feeders are not usually satisfactory. They are too easily detached by the rabbits with a consequent waste of feed.

A drawer feeder that slides in beneath the central V-shaped hay feeder has been used successfully in a number of California rabbitries. It tends to catch loose leaves from alfalfa hay and holds grain without serious waste. A projecting shelf under the V-feeder is used similarly.

The drawer is of wood with metal over the front edge to prevent gnawing. If new metal is unavailable, used metal can be smoothed out and substituted. Fasten on small cross-strips to keep young rabbits from getting into the drawer.

**Nests.** A satisfactory nest for the average-sized doe can be 12 inches wide by 12 inches high by 24 inches long. Rabbits weighing more than 10 or 11 pounds may need a longer nest; very small breeds may need less space.

An inexpensive nest can be made from an ordinary apple box, 10½ inches high by 11½ inches wide by 18 inches long, inside measurement, with top removed. A nest box of this size is satisfactory for the average-sized breeds and will serve until the young are able to jump out over the sides. Its chief drawback is in its construction that permits the doe to jump in on the young if she is suddenly frightened.

A box of the same size with the forepart of the top and upper part of the sides removed and the ends beveled off (fig. 7) is a slight improvement over the uncovered apple box. All exposed edges should be lined with metal for protection against gnawing. This type of nest would not do in a cold climate.

A nest constructed from a nail keg laid on its side is used at the United States Rabbit Experiment Station at Fontana (fig. 8). A keg with a head diameter of

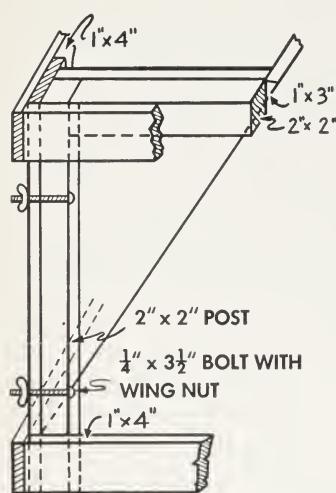
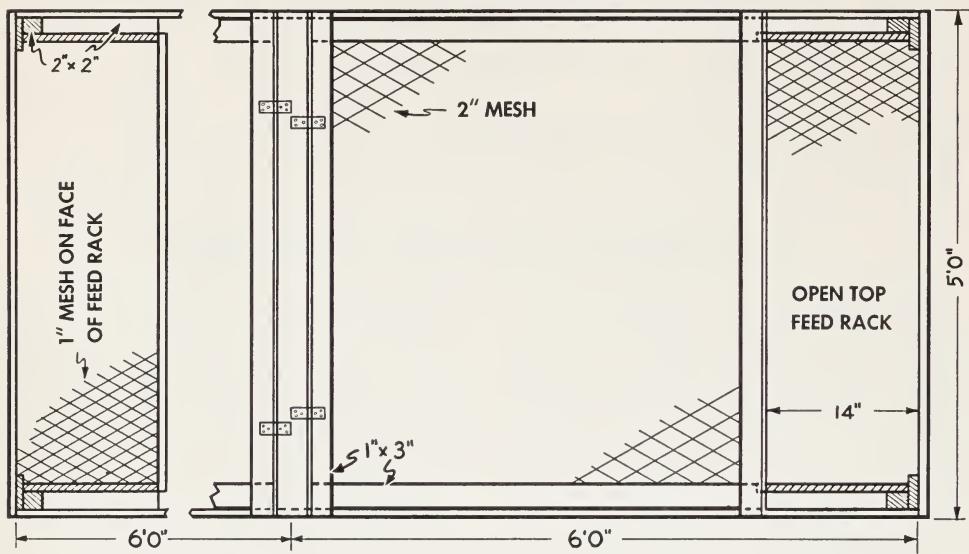
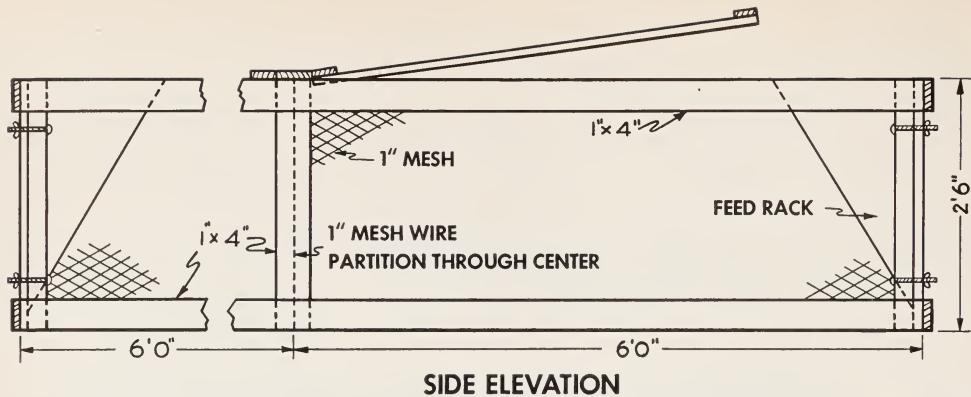


Fig. 6. Plans for a rearing pen with two compartments. About 8 to 12 weaned rabbits may be taken care of in each section. This type runway may be moved about over the green feed.

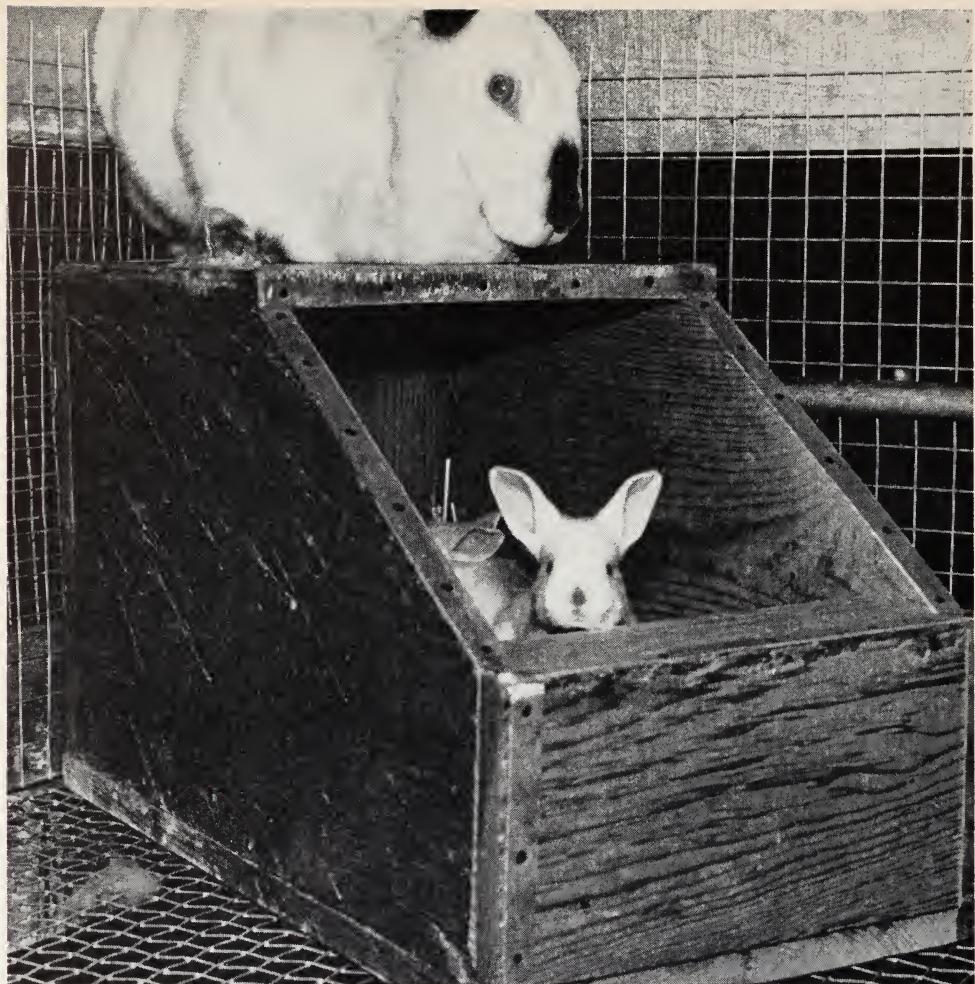


Fig. 7. Substantial nest box with exposed edges lined with metal to prevent gnawing. Top provides resting place for the mother where she can still be near the babies.

13 inches is suitable for does weighing 12 pounds or more; one with an 11½-inch diameter for does weighing from 8 to 12 pounds; and a 10-inch diameter for does under 8 pounds.

Remove the top end of the keg, and nail cleats across the lower half of the opening to confine the young rabbits and the nesting material. Rest on stand to keep the keg from rolling. When the young are about 3 weeks old, remove the upper cleat so that they can get out more easily. Nailing a smooth metal strip along the surface of the top cleat will protect the wood from gnawing.



Fig. 8. Inexpensive nest box made from a nail keg.

## CARE OF THE HUTCH

Keep the hutches dry and clean at all times. It is very easy to become careless; the moment carelessness begins diseases begin. Clean thoroughly once a week. Remove all manure that sticks to the floor with a scraper and a stiff brush before scrubbing. If the floor is very dirty scrub it with lye water—1 pound of lye to 5 or 6 gallons of water. A disinfectant is not necessary unless some specific infection requires this.

Keep feed and water in clean containers in the hutch away from manure and urine. Clean the containers frequently and scale them to remove any organic matter which has accumulated. Coccidiosis, for instance, spreads almost entirely through soiled feed, drinking water, and damp floors (see page 41).

Scrub the toilet pans thoroughly with a good disinfectant two or three times a week. See that bedding is clean and dry.

## BREEDING

### Selecting the Breed

A prospective producer familiar with local conditions will know what rabbits satisfy market demands and what rabbits do not. For example, if a market prefers fryers weighing from 1½ to 2 pounds dressed or 3 to 4½ pounds live weight, a breed that develops early and quickly reaches marketable weight at a low feed cost should be chosen. If a market prefers meat rabbits weighing 5 pounds or more, breeds that are slow to develop or do not fill out well when young are preferable.

The few breeders catering to a fur market sell the meat from the rabbits producing the fur for whatever it will bring. The meat from a 6-months-old fur rabbit will usually weigh 4 or 5 pounds or more. Dressed rabbits of this size are usually low priced, and it is important to find a market willing to take them.

Many breeds are now available for breeding stock. Newer breeds usually sell for more than old established breeds, but the beginner should anticipate a drop in prices for high-priced new breeds. The final choice in breeding stock will nearly always depend on the value of the animals for both meat and fur, since a new breed of excellent fur qualities may have no market value because pelts are not available in sufficient numbers for matching.

The comparative popularity of various breeds can be seen at commercial rabbitries and at rabbit shows. The shows

especially illustrate how closely producers are approaching the ideal standard given in "The Guide Book and Standard" of the American Rabbit and Cavy Breeders' Association.

A knowledge of this standard is essential whether a beginner hopes to exhibit or not. Table 4 includes the important breeds and their primary utility values. Fanciers may find more than one standard for some breeds. If so, it is fairly safe always to follow the standard recognized by the oldest specialty club for the breed in question.

**Terms of Breed Description.** These are defined in a glossary in "The Guide Book and Standard" already mentioned. Figure 9, which follows (p. 24), carries a few terms that may be useful in understanding some of the descriptive points discussed here.

**Breeds for the Beginner.** It is best to start with only one breed. To learn the characteristics and requirements of one breed is naturally less confusing than to learn those of several breeds. With experience and a developed market, it may be profitable to raise several different breeds to cater to different demands.

Among the meat rabbits, New Zealand Red (fig. 12), New Zealand White (fig. 9), California Rabbit (fig. 10), and Flemish Giant are very popular for their high-quality meat. Among the fur rabbits,

Chinchilla, Heavyweight Chinchilla (fig. 14), American White, New Zealand White, White Flemish Giant, Havana, Lilac, Castor Rex and its crosses, and certain blue and silver breeds are very popular for both fur and high-quality meat. Since all of these breeds are produced in quantity, stock is easy to purchase. In this way the market demand is readily met.

Some of the newer breeds might become more popular if they could be secured in larger quantities and at less expense. Introducing a little-known breed is not always a profitable undertaking. Figures 9 to 17, pages 24-26, show some of the popular breeds.

**Practical versus Fancy Stock.** The beginning breeder should start with utility rather than fancy stock. He is not yet ready to cope with the exhibition requirements of fancy stock.

**Purebreds.** A rabbit is eligible for registry as a purebred when it can meet the existing breed standard established by organized breeders. It must also show the ancestry of both parents back to the great grandsires and great granddams. The parents are usually purebreds, although at present they need not necessarily be registered purebreds.

Certain leaders in the rabbit industry have attempted to require registration of the parents before the offspring are eligible for registry. This would make for greater uniformity within the rabbit breeds, but the majority of producers have not supported the move. Registration of the parents should be followed by individual inspection by a competent registrar. This double check would guarantee that each rabbit not only was purebred, but that it also met the standard requirements for registry. A further step would be to secure a record of performance. This is a requirement of the dairy and

**Choosing Individuals.** Regardless of breed or variety, certain general characteristics affect the choice of breeding rabbits. These are:

Ability to maintain health and vigor under commercial conditions; not unduly susceptible to disease.

Meat white, fine grained, firm, and delicately flavored, if meat rabbits.

Dressing percentage high, with a large percentage of the best meat cuts (saddle); body compact and meaty with fine bone for the meat trade.

Ability to thrive on inexpensive feed.

Market weight and desirable plumpness reached at an early age.

Value sufficient to make the business profitable under existing conditions.

Able to reproduce true to color and type.

A good breeder the year around.

Females good mothers, able to bear and rear large litters.

## Principles of Breeding

the poultry industries where performance is so vital.

Registration of an animal does not indicate breeding qualities, but it does indicate that a purebred rabbit may be expected to show greater uniformity and to pass these characteristics on to the offspring with more certainty than rabbits not bred to standard. Some recognized standard is essential before systematic breeding can be undertaken. Standards for new breeds will probably be established, and changes in old standards made from time to time.

Unfortunately, a strain of rabbits whose standard characters do not breed true has sometimes been set up as a breed. In the Dutch breed, for example, the pattern called for in the standard is secured in only about 50 per cent of the offspring, although 100 per cent of the desired color pattern might be secured by using parents of selected color patterns that are not standard.

Table 4. STANDARD BREEDS AND VARIETIES OF RABBITS IN EFFECT APRIL 1, 1947\*

Breeds and varieties	Standard mature weight in pounds		Registration weight in pounds		Primary utility value
	Buck	Doe	Buck	Doe	
American (Blue and White)†	9	10	8-10	9-11	Meat, fur, show
American Silver Fox (Black and Blue)	9	10	8-11	9-12	Fur
Angora Woolers, English type	5 up	5 up	5½-7½	5½-8	Wool
Angora Woolers, French type	8	8	7 up	7 up	Wool
Belgian Hare	8	8	6-9	6-9	Meat and show
Beveren, Blue and Blue Rex	9½ up	10½ up	8 up	9 up	Fur
Beveren, White and White Rex	9 up	10 np	7 up	8 up	Fur
Beveren, Black and Black Rex	8-10	8-10	8 up	9 up	Fur
Blue Vienna and Blue Vienna Rex	9-10	10-11	8-11	9-12	Fur
California Rabbit (fig. 10)	8-9	8-9	....	....	Meat
Castor Rex	7 up	7½ up	7 up	7½ up	Fur and show
Champagne de Argent	9	10	9-11	9½-12	Fur and show
Cheekered Giant, American (fig. 17)	9 up	12 up	10 up	11 up	Meat and show
Chinchilla, American Chinchilla Giant and Rex	11 up	12 up	11 up	12 up	Fur and meat
Chinchilla, American Heavyweight (fig. 14) and Rex	9	10	10½	9-11½	Fur and meat
Chinchilla, American Standard and Rex	6-7½	6½-8	6-7½	6½-8	Fur and show
Creme de Argent	8	9-11	7-9	8-10	Fur and show
Dutch, Black (fig. 13), Blue, Chocolate, Gray, Steel Gray, Tortoise, and A.O.C.	4½	4½	3-5½	3-5½	Fur, meat, show
English (spots any color)	6-8	6-8	Not over 8	Not over 8	Show
Flemish Giant, Steel Gray, Light Gray, Black, Fawn, Sandy Gray, White, Blue, and Rex	14 up	15 up	12 up	13 up	Show
Havana, Heavyweight and Rex	9 up	9 up	7 up	7 up	Meat, fur, hatters' pelts, show
Havana, Satin	6	6	5-7	5-7	Fur and show
Havana, Standard and Rex	6	6	5-7	5-7	Fur and show

Himalayan (fig. 11) and Rex.....	$3\frac{1}{2}$ 6 up	$3\frac{1}{2}$ $6\frac{1}{2}$ up	2-5 $5\frac{1}{2}$ - $8\frac{1}{2}$	2-5 6-9
Lilac and Rex.....			Not under 9	Not under 10
Lops (English)—earage not less than 16 inches from tip to tip.....	10 up	11 up	5 up	6 up
Lops (French)—earage not less than 14 inches from tip to tip.....	$10\frac{1}{2}$ $6\frac{1}{2}$ up	7	$6\frac{1}{2}$ $8\frac{1}{2}$ $7\frac{1}{2}$	$7-9\frac{1}{2}$ $7-9\frac{1}{2}$ $7-9\frac{1}{2}$
Marten, Chocolate.....			Not under 9	Not under 10
Marten, Silver Black (fig. 15) and Blue.....	$7\frac{1}{2}$	8	5 up	6 up
Marten, Silver Chocolate.....	$6\frac{1}{2}$	7	$6\frac{1}{2}$	$7-9\frac{1}{2}$
Marten, Silver Sable.....	7	9	$6\frac{1}{2}$	$7-9\frac{1}{2}$
New Zealand (Red and White) (figs. 9, 12)—seniors only, also Red Rex and White Rex.....	10	11	9-11	10-12
Polish, White, Blue-eyed White, Black, Chocolate, and Rex.....				
Rex, Albino White.....		$2\frac{1}{4}$ - $2\frac{3}{4}$ $5\frac{1}{2}$ up	Not over 3 $\frac{1}{2}$ Not under 6	Not over 3 $\frac{1}{2}$ Not under 6
Rex, Beaver.....			Not under 7	6 up
Rex, Black.....			Not under 6 $\frac{1}{2}$	Not under 6 $\frac{1}{2}$
Rex, Blue.....			Not under 6 $\frac{1}{2}$	Not under 6 $\frac{1}{2}$
Rex, Lynx.....			Not under 6 $\frac{1}{2}$	Not under 6 $\frac{1}{2}$
Rex, Opal.....			6 up	7 up
Sable, American and Rex.....			Not over 7	Not over 7
Sable, Siamese and Rex.....			9	Not under 7
Silver (Gray, Fawn, and Brown).....	5-7	5-7	5-7	5-7
Silver Black Giant.....	6	6	4-7	4-7
Tans (Blacks and Blues).....	12 up	14 up	Not under 10	Not under 11
		4-6	$4-5\frac{1}{2}$	4-6

\* Standards recognized by the American Rabbit and Cavy Breeders' Association for seniors  
 † Working standard.

FIG. 9—NEW ZEALAND WHITE

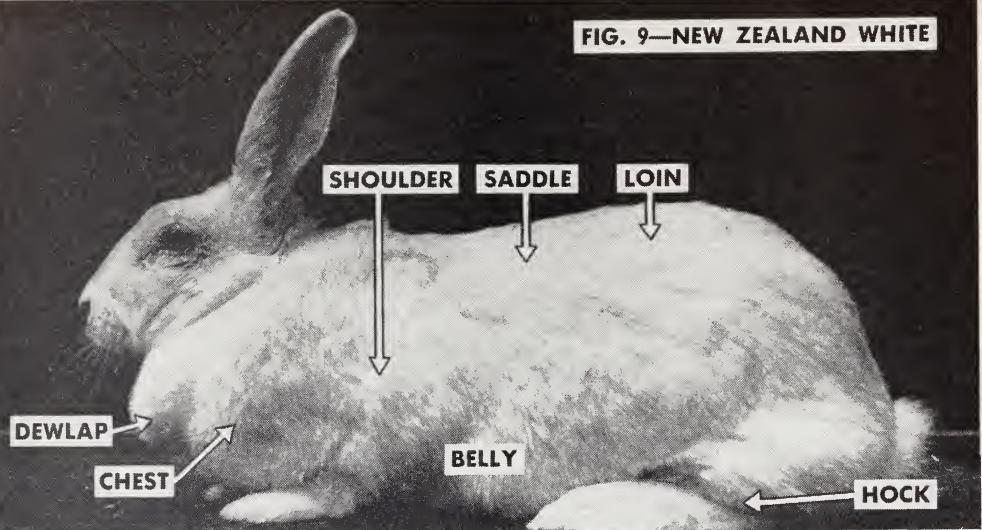
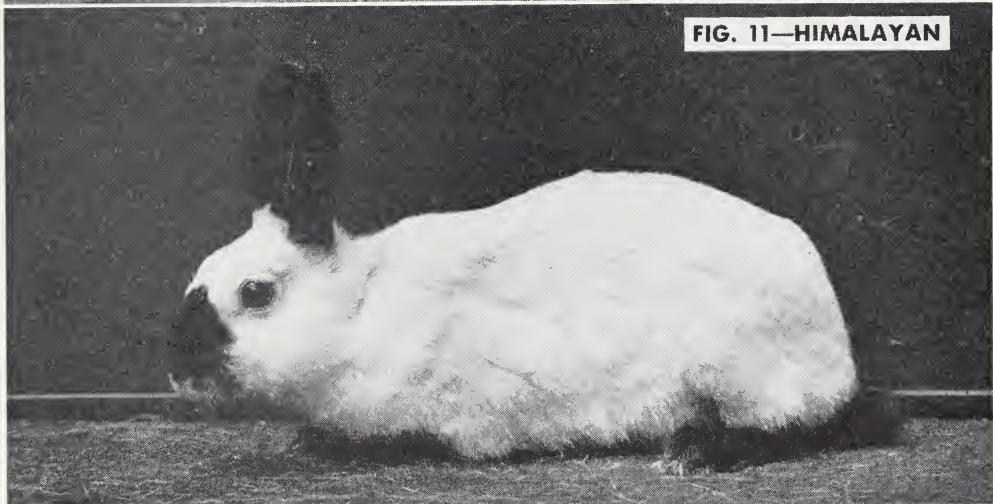


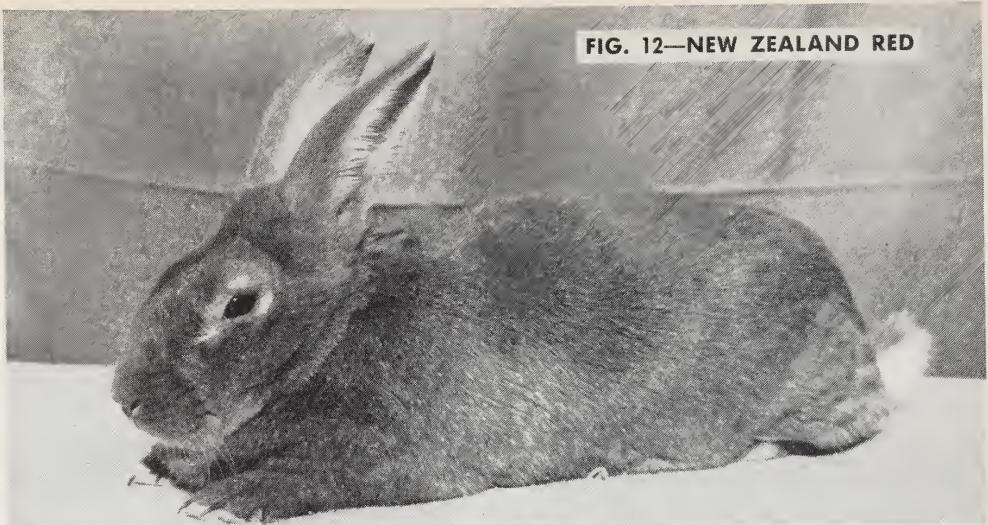
FIG. 10—CALIFORNIA RABBIT



FIG. 11—HIMALAYAN



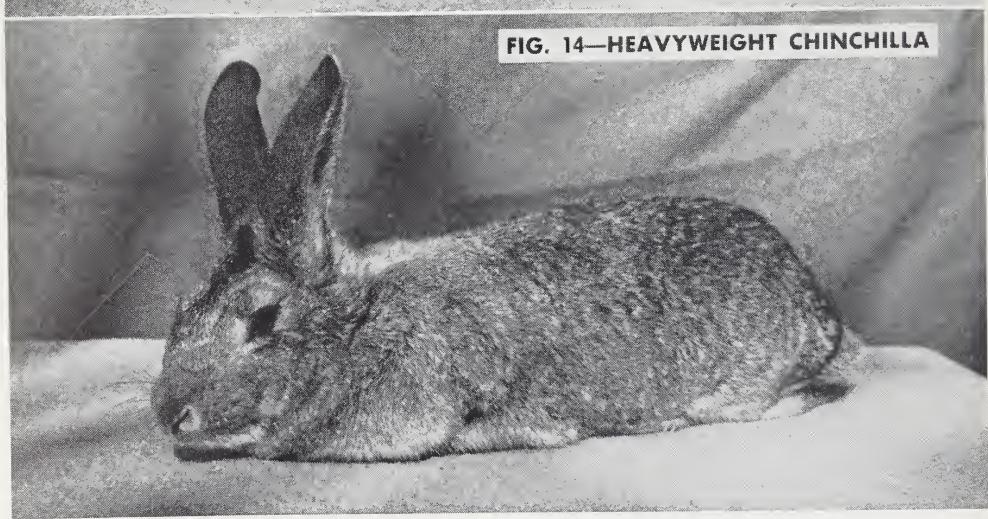
**FIG. 12—NEW ZEALAND RED**



**FIG. 13—BLACK DUTCH**



**FIG. 14—HEAVYWEIGHT CHINCHILLA**



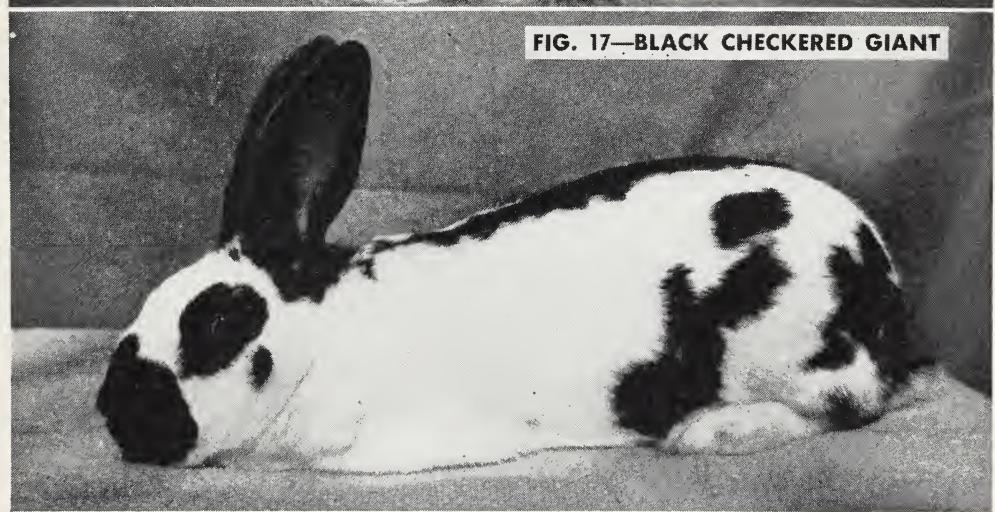
**FIG. 15—SILVER BLACK MARTEN**



**FIG. 16—WHITE ANGORA WOOLER**



**FIG. 17—BLACK CHECKERED GIANT**



**Crossbreeding.** This refers to the mating of animals of different breeds. Usually the animals in such crosses vary greatly, and the characteristics of the progeny cannot be foretold. In the mating of purebreds the characteristics can be foretold with some degree of certainty. A rabbit of unknown breeding or one which does not meet the breed standard is commonly called a "scrub."

**Line Breeding.** Line breeding is with animals from a single line of descent, as in one family or in families of a common ancestry a few generations back. Such breeding combines in the progeny the characters especially desired, and attempts to exclude everything outside the chosen ancestral line. Results can usually be predicted. In line breeding the matings should be both from the pedigree records and from individually selected animals in the pens. The type and condition of the individual are just as important as the pedigree.

**Inbreeding.** This is line breeding carried to the extreme, such as mating father with daughter or mother with son. Close inbreeding does not necessarily result in trouble if all foreign characters are eliminated and undesirable weaknesses are absent in both parents. However, the inexperienced breeder sometimes overlooks certain weaknesses which cause much trouble later. Most breeders feel safer in introducing outside or unrelated breeders after crossing father with daughter or mother with son. Outbreeding refers to this introduction of unrelated stock.

**Which Rabbits to Mate.** Rabbits should reach maturity—usually 7 or 8 months of age—and represent the best individuals in the desired type before they are mated. Related animals possessing the same fault should not be mated, even though they are worthy in other respects. By occasionally introducing unrelated stock, vigor and fecundity can be maintained more easily. Each breeder should have in mind the characters he wishes to

fix in his animals—certain ones for meat and others for fur. It is easier to fix and correlate a limited number of characters than many.

**Coat Characters.** In the domestic rabbit coat characters have been divided into 8 general groups, some of which have been subdivided. Still other characters may appear in time. Those now recognized are:

**Agouti** The agouti color of the wild rabbit has given rise to gray, and to black and tan.

**Brown** This factor governs both brown and black, since brown is a recessive from black.

**Color** This factor determines whether the rabbit will be white or colored. Color mutations give rise to albinos with pink eyes, such as the New Zealand White from the New Zealand Red and the American White from the American Blue. There are also breeds only partly mutated toward the albino, as the Himalayan. The California Rabbit is a cross between the Himalayan and the New Zealand White with markings of the Himalayan.

**Dilution** The dilution factor lightens the various colors. Black becomes blue, brown becomes lilac, yellow becomes cream, and gray becomes blue gray.

**Extension** This factor involves a modification of the yellow color. There is the dominant or dark extension; the gray extension, as in the Black Siberian and Steel Gray; the Japanese extension (yellow-brindled black); and the yellow extension.

**White spotting** There are two patterns for white spotting—English and Dutch. The length and texture of the hair are also changed in the Angora coat, which is closely associated with the English factor. English spotting, the Dutch pattern, and the Angora coat are all linked in the same chromosome.

**Vienna** This factor produces a white rabbit with colored eyes, as in the Vienna.

**Rex** This mutation produces a pelt without stiff guard hairs. (See list of breeds in table 4.)

In addition to coat characters there are blended colors such as the silvers, where inheritance is apparently complex.

Breeders wanting further information on the subject of coat characters will find the work of such men as Castle (1909 and 1926) and Punnett (1912, 1915) valuable. The possibilities of new color combinations are far from exhausted, but the commercial rabbit raiser will probably profit most by selecting established breeds and keeping them up to their maximum possibilities. He should leave the development of new breeds to the specialist.

**Inheritance of Fecundity.** Body weight regulates the size of litter (Gregory, 1932). Heavy does tend to have large litters, small does small litters. Averages for all breeds studied show that to produce one normal young there must be slightly over 1 pound body weight. A Flemish Giant doe weighing 12.3 pounds had a potential fecundity of 12.88 young, a Chinchilla weighing 7.97 pounds, 9.17, and a New Zealand Red weighing 8.6 pounds, 11 young.

The number of young finally born, however, may be influenced by such factors as calcium and phosphorus deficiency, infectious diseases, or parasites. In the experiments by Gregory (1932), the Flemish averaged 10.2 young born and the New Zealand Red averaged 8.02. This represents a mortality of 21.1 per cent for the Flemish and 27.0 per cent for the New Zealand Red based on the potential fecundity listed above.

**Inheritance of Size.** Size in rabbits is regulated by inheritance and food rather than by glands. If the glands are involved, the effect is of secondary nature, as between male and female (Goss and

Gregory, 1932). Size is inherited equally from both parents. Rabbits of large breeds will give rise to large offspring when the environment is favorable. Offspring of large breeds normally grow faster than the young of small breeds.

**Inheritance of Fertility.** Failure to breed (see page 29) is frequently reported, especially late in the year. Reproduction in the domestic rabbit at other seasons than spring has been brought about by planned breeding and management. Rabbits differ in the extent to which they breed out of season, but whether food and temperature or inherited constitutional vigor make them successful breeders is not definitely known. While the possibility of inherited fertility should not be ignored, the greatest attention should be given to an adequate and well-balanced ration, good housing, and opportunity for normal development.

**Resistance to Disease.** Resistance to disease is believed to be related to a combination of factors, although little is definitely known about its inheritance. Certain strains of rabbits seem to be remarkably free from snuffles, for example. This fact has led some breeders to believe that resistance to disease is inherited, and that breeding stock should be selected from strains that have proved comparatively free from common ailments.

Regardless of whether or not resistance is inherited, only strains of a breed which has proved sufficiently vigorous to escape disease should be selected when available. This is one reason why the beginner should not inbreed too closely.

## Practice of Breeding

The early part of the year is the normal breeding season for rabbits, with February and March showing the highest percentage of conception. Failure to breed is reported most often from August to October.

The doe does not have an estrus cycle as have the cow, sow, ewe, and mare. But

if a doe is restless or nervous and rubs her chin against parts of the hutch, she may be ready for breeding. She can then be taken to the buck's hutch, never the buck to her hutch because she is more inclined to fight when bred in her own quarters. If the doe is ready, the mating should occur almost immediately. Usually

the buck falls over on one side when the mating is completed. Then the doe may be returned to her hutch.

If the doe does not readily accept service, she may be restrained by a method developed by the United States Rabbit Experiment Station. With the right hand, hold the ears and skin over the shoulders, and place the left hand under the body and between the hind legs. Force the tail upward with the index finger. In this position the weight of the doe's body is supported by the left hand and the rear quarters are raised to the normal height in mating. Where bucks are accustomed to being handled, this method will insure satisfactory mating, but it does not necessarily mean that all of the does bred will kindle (Templeton, 1938).

**Failure to Breed.** Restlessness may indicate failure to conceive. There may be one or more causes. In summer, it may be high temperatures; late in the year it may be feed with too low a protein content; or it may be poor general physical condition.

If a doe is either too fat or too thin, or is in molt, she should not be bred. If she continues to have trouble in spite of the use of the best breeding methods, she should be discarded as a breeder.

**False Pregnancy.** If false pregnancy occurs, the doe will pull fur to build a nest well in advance of kindling—usually within 18 to 22 days after mating. She will also fail to put on flesh or to show other signs of pregnancy. When this happens, she should be test-mated or given the palpation test.

**Testing for Pregnancy.** In testing the breeder returns the doe to the buck to see if she will take him. If she complains and avoids him, she has probably been successfully bred. Since in false pregnancy the doe may not conceive during a period of 17 days, test-mating should start on the eighteenth day after mating. In this way the operator can detect how many does have not conceived. Does that have not been affected with false

pregnancy in past matings may be tested a few days after mating (Templeton, 1940).

The palpation test is more certain than test-mating and is time saving. If the doe has been successfully bred, the young embryos should be sufficiently large to be felt easily from the outside by the fourteenth day of the gestation period. Experts can feel them by the twelfth day. If the doe has not been successfully bred, she can be mated again. This method, developed at the United States Rabbit Experiment Station (Suiror, 1946), should be of great help in increasing the number of litters per doe in a rabbithry.

**The Buck.** A young buck should be used only once or twice a week at first. After maturity, a buck may be allowed to serve 3 does a week. One mature buck should be allowed for each 10 does. Where possible, have more than one buck available. If a buck does not sire good litters, a change can then be made. If a buck bred to several does fails to get good litters, discard him.

**Number of Annual Litters.** A doe may be expected to have a maximum of 4 litters of vigorous young each year. The average in southern California for 1947 was 3.8 litters per doe. The doe should remain a good breeder for at least three years. This ideal is possible, but only occasionally attained in actual averages. The number of litters may be reduced because of heat, disease, or poor management. In order to average 4 litters a year, a doe should be bred once every 3 months or 91 days. Since the gestation period is about 31 to 33 days, and the doe nurses her young for at least 4 weeks, it will not be safe to breed her again until the young are at least 4 weeks old.

Many producers of fryer rabbits prefer to leave the young with the doe until they are about 60 days old. This prevents the temporary loss in weight which follows weaning at 4 to 6 weeks. Even by waiting until the young fryers have reached 4 pounds live weight—at approximately 60

days—before breeding the doe again, it should still be possible to have 4 litters a year.

In the hotter sections of the state, plan as few litters as possible for July and August. This is the time of greatest infant mortality, and this is the time in some years in California when prices have been low. Plan to have 2 litters arrive during the time of high prices and another shortly after Easter when meat and fur prices are still fairly good. This will allow only 1 of the 4 yearly litters for the summer. The rest period between litters should not be too long, however, or successful breeding will be hindered.

**Kindling.** A few days before the doe is ready to kindle, place a nest box in one end of the hutch, opposite the central feeder, if one is used. Furnish straw nesting material. Just before kindling, the doe will make the nest, normally lining it with hair or fur pulled from her belly. Be certain that the hutch is protected. She must not be frightened by dogs, cats, or other animals just before kindling or she may scatter the young about the hutch and cause their death. After kindling she will be thirsty. Give her plenty of water. The milk flow will not start until a few hours after kindling.

The young are born naked with their eyes closed. If the doe covers them with too much fur during a hot spell, remove part of the fur so that they will not be

smothered. In very hot weather, the young may be taken from the nest during the middle of the forenoon and kept in a hardware-cloth basket suspended from one side of the hutch until the air has cooled somewhat in late afternoon. Return them to the nest (Templeton, 1938) in late afternoon.

**Size of Litters.** A doe should not be allowed to keep more young than she has nipples. Most rabbits have 8 nipples, but some Belgian Hares have only 6. Therefore, it is best to reduce the number of young in a litter to 6 or 7, regardless of breed. A litter of 6 may actually weigh more at 2 to 3 months of age than a litter of 8.

In one instance, 2 consecutive litters from a doe of a light-weight breed were weighed from time to time; a litter of 6 weighed 17.8 pounds at 2 months compared with 13.4 pounds total weight for a litter of 8. At 3 months the total weight of the litter of 6 was 22.8 pounds, and the total weight of the litter of 8 was 19.5 pounds. The total weight of the litter of 8 did not pass that of the litter of 6 until about the sixth month. Meat breeds in California will weigh more than the rabbits reported above.

With modern methods of feeding and management, New Zealand Whites or Reds or Californias should reach a weight of 4 pounds in about 60 days.

## FEEDS AND FEEDING

Milk is normally a balanced ration for newborn rabbits for the first week or two. As they grow older they will require a balanced ration consisting of suitable

amounts of protein, carbohydrates and fat, mineral matter, bulk or roughage, and vitamins. It should be palatable, furnish variety, and contain sufficient moisture.

## Terms Used in Ration Formulas

The terms protein, carbohydrates and fats, mineral matter, bulk or roughage, and vitamins appear in all ration formulas. An operator needs to know what these terms mean.

### Protein

The nitrogenous or muscle-building part of feed is called protein. About 16 per cent of the plant protein is made up of nitrogen.

## **Carbohydrates and Fats**

Carbohydrates, supplied mostly by starches and sugars, give heat and energy. Fat also gives heat and energy and is slightly more than twice as effective for this purpose as carbohydrates.

Proteins, carbohydrates, and fats are broken up into simpler compounds during the digestive process. These are either burned in the body to supply heat and energy or are used in the formation of body tissues. Unused nitrogenous and mineral products are eliminated through the kidneys, and waste carbon through the lungs.

The ash left after the nutrients are burned in the body is either acid or alkaline. That of cereals is normally acid, whereas that of most hays and vegetables is alkaline. Feed a surplus of hay and vegetables at all times to prevent acidosis, a condition which tests have disclosed can cause the death of an entire litter within 10 months. Even though grain and concentrates may be cheaper than alfalfa as a source of digestible nutrients, alfalfa balanced with a cereal should be used as an important part of the ration.

## **Mineral Matter**

Mineral matter is one of the essentials in rabbit feed. The mineral content of alfalfa hay is high, well above any normal requirement, with the possible exception of common salt. The common grains, such as barley, corn, oats, and wheat bran are low in calcium. If these grains are fed in large amounts, the ration will be low in calcium. If the ration consists of equal parts of a legume hay and grain, however, salt will be the only deficiency and this is fed separately by most operators. It may be fed in the proportion of  $\frac{1}{6}$  to  $\frac{1}{2}$  of 1 per cent of the total concentrates fed to both young and older rabbits.

Mineral supplements for rabbits have been credited with causing unusual growth. These claims are often unfounded. Rabbits fed mineral supplements have not always put on more weight

than those fed solely on alfalfa hay and barley. But if alfalfa hay is abnormally low in ash, because of some soil condition, or if the ration as a whole is lacking in lime, inexpensive ground limestone should be added to the concentrate part of the ration.

Mineral deficiency is indicated by rickets or leg weakness. This is directly traceable to calcium and phosphorus deficiency, or to a failure to assimilate these minerals. This condition calls for a ration such as that listed on page 37, including a high protein supplement. Remember that the assimilation of calcium is dependent on the presence of the ultraviolet rays of direct sunlight.

## **Vitamins**

These factors in feed help to maintain good health. The reaction of several of the vitamins on rabbits is well known; that of others is unknown or is not well understood. Some vitamins are unstable in ordinary feed mixtures. Certain ones are stored in the body, others are not. It is therefore very important to include a good variety of feeds known to contain the essential vitamins.

**Vitamin A** is supplied by plants or plant products containing carotene. Carotene is the yellow pigment in the green part of all plants and in the yellow parts of such plants as carrots and yellow corn. Carotene is transformed into vitamin A in the liver; any surplus of vitamin A is also stored in the liver.

The process of curing green alfalfa hay destroys much of the carotene content—that of baled alfalfa hay being estimated at about 25 per cent of that of green alfalfa. The proper curing of hay preserves a maximum amount of the green color. This will insure a high carotene content, which gives an adequate supply of vitamin A to the animal.

All requirements for vitamin A may be satisfied by including high-grade leafy alfalfa hay and greens in the bulk part of the ration. Yellow carrots are an ex-

cellent source of vitamin A. Milk also contains some. A deficiency in vitamin A tends to dry the surface tissues of the respiratory and digestive tracts and leaves

them susceptible to infection. A severe and prolonged deficiency leads to night blindness and, ultimately, to permanent blindness or even to death.

**Table 5. VITAMIN CONTENT OF RABBIT FEEDS**

Feeds	Vitamins						
	A	B <sub>1</sub>	C	D	E	G complex	K
<b>Cereals</b>							
Barley.....	0 to +	++	0	0	++	+	-
Corn, yellow.....	++	+++	0	0	++	+	-
Milo, etc.....	0	++	0	0	++	-	-
Oats.....	0	++	0	0	++	+	-
Wheat.....	0	++	0	0	++	+	-
<b>Cereal by-products</b>							
Peanut meal.....	0	++	0	0	++	-	-
Rice polishings.....	0	++	0	0	++	-	-
Soybean meal.....	0	++	0	0	-	+	-
Wheat bran.....	0	++	0	0	++	+	-
Wheat germ.....	++	++++	0	0	++++	+	-
Wheat middlings...	0	+++	0	0	+++	+	-
<b>Animal products</b>							
Cod-liver oil.....	++++	0	0	++++	0	0	-
Sardine oil.....	++++	0	0	++++	0	0	-
Shark-liver oil.....	++++	0	0	++++	0	0	-
Skim milk, dried...	0	+	0 to +	0	+	+++	-
Whole milk.....	++	+	+	0 to +	+	++	-
<b>Greens and hay</b>							
Alfalfa, green.....	+++	+	+++	0	+++	++	+++
Alfalfa hay, green and leafy.....	+++	+	0	++	+++	++	+++
Beet leaves.....	++	+	-	-	-	+	+++
Cabbage leaves, green.....	++	+	+++	0	-	+	+++
Carrots, yellow and leaves.....	+++	+	++	0	-	+	+++
Chard leaves.....	+++	+	-	-	-	+	+++
Clover, green.....	+++	+	+++	0	+++	++	+++
Grasses, green.....	+++	+	+++	0	+++	++	+++
<b>Miscellaneous</b>							
Yeast.....	0	++++	0	0	0	+++	-
Molasses, cane....	0	++	0	0	++	-	-

+ Contains vitamin  
++ Good source of vitamin  
+++ Excellent source of vitamin  
++++ Very rich in vitamin

- Amount unknown  
0 None or no appreciable amount

**Vitamin B<sub>1</sub>** may be purchased in pure crystalline form as thiamine hydrochloride and fed according to directions. However, a rabbit ration containing a variety of whole grains or the germ and bran part of such grains should supply an adequate amount of this vitamin. A deficiency of vitamin B<sub>1</sub> leads to nervous disorders. There is little excuse for a rabbit ration to be deficient in vitamin B<sub>1</sub>.

**Vitamin C (ascorbic acid)** prevents scurvy. It is of minor importance in a rabbit ration since rabbits are not subject to scurvy.

**Vitamin D (antirachitic factor)** is produced in plants and animals through the action of the ultraviolet rays of the sun. When these light rays strike the skin of an animal, they change certain substances to vitamin D. This is why the vitamin is often referred to as the "sunshine vitamin."

A vitamin-D deficiency in young animals leads to rickets—characterized by lameness, swollen joints, and bone deformities—and to leg weakness. Regardless of the amount of calcium and phosphorus in the diet, animals cannot make use of them unless vitamin D in some form is provided. Dark hutches or continued cloudy weather may produce rickets unless liberal amounts of vitamin D are in the ration.

**Vitamin E (antisterility vitamin)** is present in whole grains, milk, fresh greens, and alfalfa hay or alfalfa meal. The popular rabbit rations usually include this vitamin.

**Vitamin-G complex** includes both riboflavin (lactoflavin) and the antidermatitis or filtrate factor. The vitamins making up this complex are soluble in water and are not destroyed by heat. Riboflavin is important to the utilization of food and to growth. It is present in green feed, both fresh or dried, and in milk. The filtrate factor is essential for good growth and has been suggested for the breeding diet. Molasses is a good source. Any marked deficiency in vitamin-

G complex would indicate that the whole ration needed revision.

**Vitamin K** is usually referred to as the antihemorrhagic vitamin necessary for normal blood clotting. It is abundant in alfalfa hay and green feed and is also found in bran and soybean meal.

Tests have been conducted on various feeds to discover their vitamin content (Daniel *et al.*, 1937; Booker *et al.*, 1939). These tests are by no means complete, but some of the facts discovered about the vitamin content of popular rabbit feeds appear in table 5.

**Bulk** prevents indigestion and impaction. Rabbits are able to use feed with a large amount of crude fiber; yet, if there is too much indigestible fiber, the feed will have insufficient total nutrients to insure good growth and health.

Alfalfa hay cut before bloom is relatively low in fiber; it ranges from only 18 to 20 per cent. Coarser types of alfalfa hay in the advanced blossom stage may run as high as 30 per cent fiber. Coarse hay is totally unsuited to rabbits.

The fiber content of grain must be considered in total weight per bushel. The fiber average for barley grain is about 4.6 per cent. Barley grain is worth about 5 per cent less for each per cent of fiber above the average. A good variety of barley should weigh 42 pounds or more to the bushel, but some barley meeting this weight may still be rather high in fiber. Grains rolled or ground into meal may contain large amounts of concealed fiber.

Carbohydrate content and real value of the grain are fairly closely related. In practice, however, it is hardly possible to do more than to know that the grain is plump and as heavy as possible per bushel. If pelleted feed is used, the responsibility for regulating the crude fiber then rests with the feed miller.

Oats run much higher in fiber than barley and are usually more expensive. They are used very little in California, so are not considered in this circular.

## Whole versus Ground Feed

Rolled barley has been fed to rabbits for years. The extra cost of rolling, however, makes it an expensive feed. Experiments at the College of Agriculture at Davis disclosed that rabbits past the nursing age made as good gains on whole barley as on either the rolled or ground form.

Tests at the United States Rabbit Experiment Station indicated that grinding, rolling, or pelleting cereal grains did not increase their feeding value. It would therefore seem best to use the whole grains whenever practical to reduce feeding expenses. Poor quality is readily detected in whole grain or unground alfalfa.

## Pellet Feeds

The use of pellet feeds for rabbits has increased rapidly since 1930. By 1947 it was used by all coöoperators in the Southern California Rabbit Management Study. Although complaints about faulty nutrition often seem due to insufficient protein in pellet feeds, many rabbit raisers have used this type of feed exclusively, with excellent results. If it contains the proper nutrients it should serve very well. (A

carrier for pelleted feed is shown in figure 18.)

The composition of almost any common rabbit feed is given in reference books on feeds. The digestibility tables are usually based on tests with cattle and sheep, but they can also be taken as a partial guide in checking on the total digestible nutrients present for rabbits. If you know this total, compare similar feeds for cost at current quotations.

## Feed for Variety and Palatability

Rabbits definitely prefer certain kinds of feeds. This was demonstrated by feeding trials with self-feeders at the United States Rabbit Experiment Station (Templeton *et al.*, 1942). In order of preference, the grains may be listed as oats, wheat, milo, barley, and corn. When pellets consisted of plant proteins, the order of preference was peanut meal, soybean meal, sesame meal, linseed meal, cotton-seed meal, and hempseed meal. High-grade alfalfa hay was relished. And green feed, such as alfalfa, or succulent feed, such as yellow carrots, was readily accepted by nearly all kinds of rabbits.

A ration containing alfalfa hay, barley, and a few yellow carrots or greens would probably be better relished by rabbits than a ration of alfalfa hay alone. There would also be less likelihood of food deficiencies.

Mill products in the form of mash or pellet feed give considerable variety, but in many instances the cost of the total ration is too great. These products contain wheat, bran, shorts, middlings, mill

run, ground barley, ground corn, ground milo, linseed meal, cocoanut meal, oat chop, and salt.

Rabbits should become accustomed gradually to change in feed. A sudden change, even for improvement, may cause a temporary digestive disturbance. When they refuse to eat new kinds of feed, mix a little of the new with some of the old feed that is relished.

Certain wild plants **can** be fed to rabbits if they are cut while green and succulent and are wilted overnight before being used. Other wild plants are undesirable or harmful to rabbits and **cannot** be fed.

Plants which **can** be fed to rabbits:

Bermuda grass (*Cynodon*)  
Bur clover (*Medicago denticulata*)  
Chicory (*Cichorium intybus*)  
Clovers (*Trifolium pratense*, red clover; *T. repens*, white clover; *T. hybridum*, alsike clover)

Dandelion (*Taraxacum officinale*)  
Filaree, alfileria, or stork's bill (*Erodium*)



Fig. 18. Feed carrier with capacity for three sacks of pelleted feed.

Foxtail or wild barley before heading (*Hordeum murinum*)

Johnsongrass, first cutting (*Holcus halepensis*)

Lettuce, wild or prickly (*Lactuca scariola*)

Malva or mallow, cheeseweed (*Malva parviflora*)

Morning-glory, wild (*Convolvulus arvensis*)

Mustard, wild black (*Brassica nigra*)

Oats, wild—when green (*Avena fatua*)

Plantains, common (*Plantago major*) and English, or ribwort (*P. lanceolata*)

Thistle, Napa (*Centaurea melitensis*), and yellow star (*C. solstitialis*)

Plants which **cannot** be fed to rabbits:

Burdock (*Arctium minus*)

Chickweed (*Stellaria media*)

Clovers (*Melilotus alba*, sweet clover; *M. indica*, sour clover)

Fireweed (*Epilobium angustifolium*)

Goldenrod (*Solidago californica*)

Horehound (*Marrubium vulgare*)

Lambsquarter and similar species (*Chenopodium*)

Lupine (*Lupinus*)

Milkweed (*Asclepias speciosa*)

Miner's lettuce (*Montia perfoliata*)

Poppies (*Eschscholtzia*, *Papaver*, etc.)

Ragweed (*Ambrosia*)

Tarweed (*Madia*)

Turkey mullein (*Eremocarpus setigerus*)

Several cultivated forage plants may be fed: green alfalfa, green barley, and beet or chard leaves. Feed less of kale and cabbage leaves. Kale and other members of the mustard family give a very strong odor to the urine; they are also more likely to cause bloat than other greens.

Alfalfa leaf meal and yellow carrots have proved fairly good occasional substitutes for greens in poultry feeding. Either of these feeds is suitable for rabbits, but alfalfa meal should be fed only with other feeds in a dampened mash or in pellet form. A rabbit cannot eat finely ground feed. Alfalfa leaf meal should average over 20 per cent protein, which is well above the percentage in alfalfa meal. The fact that alfalfa leaf meal is used as a valuable substitute for greens, however, has prompted some manufacturers to produce meal with a very low protein content. Naturally this type of meal will not give satisfactory results. A good grade of alfalfa hay will usually be the most economical for bulk, and yellow carrots or various grasses for the necessary succulence.

**Amount to Feed.** If rabbits are supplied with a good grade of alfalfa hay, grain, and protein supplement, one or two feedings daily will be sufficient. Have the evening meal the larger one as they eat more at night than in the daytime. Alfalfa hay may be fed in the morning and hay and grain at night.

Hand-fed rabbits should be made to clean up their feed before receiving more. Refusal may mean that the quality of the

feed is poor or that the lengths of hay are too long. Many rabbit raisers now chop the hay to prevent waste. A saw can be used to cut alfalfa hay into 3-inch lengths.

The amount of feed to allow will depend on the age, condition, and size of the animal. The average for all rabbits in the 1948 Southern California Rabbit Management Study was 4.8 pounds of mixed feed per pound of rabbit produced. Roaster rabbits have consumed 5.5 pounds of mixed feed per pound of rabbit produced. The daily ration for the older does and bucks will include about 2½ ounces of concentrates and all the alfalfa hay they will eat. Allow about 1/10 pound green feed or root crop for a mature rabbit of medium weight.

For does and litters over 2 months of age, feed daily a limited amount of the concentrate mixture, along with alfalfa hay and 1/10 pound of green feed or root crop. Full feeding of the concentrated portion of the ration to young weaned rabbits causes them to put on too much flesh for optimum results. It may be best not to feed greens to rabbits under 2 months of age, which is the normal age for marketing fryers. Operators have had a great deal of trouble when giving green feed to rabbits under this age.

Young rabbits will eat more per pound live weight than older rabbits; a liberal allowance should be made—up to 1 ounce dry matter per pound live weight. The animal that is not growing and is not being used as a breeder can get along very well on the minimum allowance of about 2/3 ounce dry matter per pound live weight.

It is not essential to change the ration greatly between winter and summer. According to G. S. Templeton, director of the United States Rabbit Experiment Station, a doe and her litter of 7 will consume, from time of mating to weaning in summer, an average of 79.30 pounds of feed. The consumption in winter averages 88.81 pounds. While the doe and litter consume more feed during winter, the

fryers also weigh more at that season. The feed required to produce a pound of fryer was practically the same for winter and summer—3.46 pounds in winter and 3.45 pounds in summer.

**Feeding the Nursing Doe.** From breeding to kindling, the daily consumption of a mature doe of the New Zealand White breed is approximately 0.16 pound concentrates, 0.24 pound alfalfa hay, 0.10 pound green feed, or a daily total of 8 ounces of hay and grain. Feed the doe liberally during pregnancy and be certain to include a good supply of protein in the ration.

Food for a nursing doe needs special consideration. During the first week after kindling a 10-pound doe will do well on a normal daily ration of approximately 5 ounces of hay and 4 ounces of grain. After the first week give her as much grain as she will clean up. Whole grains and germ meal are rich in B<sub>1</sub>, which she needs. Also give her greens for additional B<sub>1</sub>.

**Feeding the Doe and Litter.** A doe with young over 2 weeks old will consume two to three times the normal amount of feed. As the young grow and begin to eat, the doe and litter will need as much as 18 ounces of grain daily. They will also need a greater amount of hay.

Over a 60-day period, with hand feeding, a New Zealand White doe and litter of 6 would average close to 19 ounces of hay and 13 ounces of concentrates daily. With a self-feeder the average would be nearer 16 ounces of concentrates and a little over 8 ounces of hay for the same period.

The amount consumed for each pound gain live weight was taken for a 56-day period, with both hand feeding and a self-feeder. With hand feeding, where hay made up 60 per cent and concentrates 40 per cent of the ration, a doe and litter consumed 2.12 pounds of concentrates and 3.18 pounds of hay for each pound gain live weight (average nutritive ration 1:3.7). With a self-feeder a doe and litter

consumed 2.50 pounds of concentrates and 1.04 pounds of hay for each pound gain in live weight.

In a self-feeder test without protein supplement a doe and litter of the New Zealand White breed consumed 2.62 pounds of concentrates and 1.40 pounds of hay and greens for each pound live weight. When the plant-protein supplement was included, the doe and litter consumed 2.50 pounds concentrates and 1.04 pounds hay and greens for each pound live weight.

At first the young will eat as much pellet plant-protein supplement as all grains combined, but the general average is  $\frac{2}{3}$  grain and  $\frac{1}{3}$  protein supplement.

The adequate ration (Templeton *et al.*, 1942) for a doe and her litter will include the following:

#### **1. Roughage:**

*a.* Chopped alfalfa hay—whatever amount the rabbits will clean up. (May substitute clover or other legume hay.)

*b.* Green feed—about 1/10 pound daily per doe, and fed only in racks above the floor where it cannot be contaminated. Alfalfa, grass, carrots, or other wholesome greens will serve. (May supply 60 per cent of ration when hand-fed, or up to 30 per cent when concentrates are fed in a self-feeder.)

#### **2. Concentrates** (allow about 40 per cent if hand-fed or up to 70 per cent when fed in self-feeders):

*a.* Cereal grains, 4 parts, by weight, to include 2 or more of the following: whole barley, whole wheat, and whole milo. (Suggest feeding wheat when old crop milo is not palatable. At other times select whichever grain is relatively the most economical.) For herd bucks, dry does, developing does, and bucks, the concentrates may include 2 parts whole grain and 1 part protein supplement. Allow about 2½ ounces of concentrate mixture daily for animals of medium weight.

*b.* Protein supplement—2 parts by weight, selected from the following: Soybean meal, linseed meal, peanut meal, or sesame meal. (Suggest either pellet or pea-sized oil-cake form; pellets may be 3/16 inch in diameter

and  $\frac{1}{8}$  inch in length. If necessary to feed in meal form, half the grains should be rolled to prevent the meal from settling out, and the mixture should be dampened just before feeding.)

**3. Salt**—added as sifted salt to the ground part of the ration or as salt spools, allowing 0.16 per cent of the concentrates by weight.

**4. Water**—available at all times.

#### **Feeding for Prime Pelts and Furs.**

The well-balanced ration which keeps the rabbit healthy and in growing condition also favors prime pelts and furs with good luster. There is little reason to change the type of ration during the 2 or 3 weeks before pelting. Density and length of fur are largely a matter of breeding.

**Buying of Feed.** Buy for the digestible nutrients present in feed, and measure the economy of a ration by total feed cost in the rabbitry for pounds of meat or other products sold rather than by feed cost per doe and litter. There is a wide range in the prices of suitable feed. Some operators fail to show good profit because they buy in insufficient quantities or during high prices. For instance, alfalfa hay in ton lots usually costs less than by the bale, and barley less by the ton or half ton than by the sack. As a rule, the price of barley is lower soon after harvest than at any other period of the year. This is not true of alfalfa.

Poor grades of hay, grain, or pellet feed are not economical at any price. On the other hand, the best grades of alfalfa hay, sometimes called "rabbit alfalfa," are expensive. A moderately good grade of hay with high protein and low fiber content is all that a rabbit raiser can reasonably expect.

Some operators attempt to grow part of the feed, but this is not advisable if the land is high priced or the cost of production high. It may pay to grow enough green feed for the minimum daily requirement of about 1/10 pound for each breeding doe.

Other operators reduce costs greatly by mixing their own feeds. City operators

without storage space can hardly buy the separate ingredients in large enough quantities to save cost. In some sections of the state, a movement has been started to buy alfalfa hay and perhaps other supplies coöperatively. Such a plan is feasible if the organization is well managed, but members tend to withdraw whenever prices are not entirely satisfactory. Of

course, it is recognized that some operators may be in a position to buy advantageously outside of an organization. A rabbit raiser must be able to work easily with other people if he plans to buy coöperatively.

The problems of feed costs are discussed under "Business Aspects," on page 56.

## MISCELLANEOUS CARE OF RABBITS

**Carrying the Rabbit.** One of the first lessons in rabbit keeping is how to carry a rabbit. Never pick it up by the ears or the feet. Always take hold of the loose skin over the shoulders with one hand and place the other hand under the rump to support the weight from beneath (figs. 19, 20). Turn its feet away from you so that it will be less likely to scratch if it

struggles. If it struggles simply rest it on the ground or on a table until it is quiet.

**Handling.** Young rabbits should be handled as little as possible. If they are placed in a wire basket during the hot part of the day, handle them gently. Older rabbits being fitted for show should be handled often enough to make them gentle on the judging table.



Fig. 19. Support body of rabbit with left hand. Tuck rabbit's head under left arm. Use right hand to grasp skin over the shoulders in case the animal struggles.

**Marking.** Valuable rabbits are usually marked with a tattoo needle on the inside of the left ear (fig. 21). The right ear is for registration only. The tattoo needle may be the small pen-sized type. Large-scale rabbit raisers may prefer one of the electric tattoo sets suitable for marking a large number of rabbits at a time. Marks may consist of a number and letter or letters, such as DE-25, or the year, month, and day, as 49-5-10. These numbers or letters are then entered on the registry and pedigree blank. The method of tattooing saves time in looking up dates.

For temporary marks during exhibition simply wipe off the waxy surface of the ear with a vinegar-moistened pad and mark with a moistened indelible pencil. Do not have the cloth or pad too wet.

**Protecting against Hot Weather.** Protection against high temperatures is discussed under the construction of lath shelters (see p. 14). In addition to the shade of a lath shelter or trees, sprinkle water on the floor or ground around the hutch to cool the atmosphere, but do not let any of the water splash on the hutch floor. See that the hutch itself is well ventilated. In a hot climate remove the upper part of the hutch back, if it is boarded solid, and cover the opening with wire, as shown in the hutch plans described on page 10. Provide plenty of fresh water during high temperatures, but reduce the grain to a minimum and cut down the ration as a whole to prevent the rabbits from becoming too fat.

The method of keeping baby rabbits in a wire basket during the hottest part of the day has practically eliminated baby-rabbit mortality from heat at the United States Rabbit Experiment Station at Fontana (Templeton, 1938).

**Protecting against Cold Weather.** Board in the back wall of a hutch in a cool climate as discussed on page 13. Wire floors should also be protected. This is possible by an overhang of the roof in front or by keeping the hutch beneath a shed roof. In addition, canvas or burlap



Fig. 21. Identification letters and number should be tattooed inside left ear.

should be hung from the edge of the overhanging roof at the front of the hutch unless the hutch is protected by a shed roof.

**Care in Developing Pens.** When moving developing pens to different feeding spots, be careful that the rabbits' feet are not caught in the wire flooring when setting the frame down. The hocks of both the young rabbits and the doe could be injured (see "Sore Hocks," p. 48).

**Castrating.** Growth between males and females does not differ materially until after market age; consequently, castration has no advantage for ordinary meat stock. If fur rabbits are to be kept for 6 months or longer, there may be a slight advantage in castration, provided the market wants large rabbits. The meat of castrated rabbits is called Lapan.

## DISEASES AND REMEDIES

Every operator should know enough about rabbit diseases and their treatment to recognize symptoms and either treat the animal or consult a competent veterinarian. Studies reported for 1948 show an average annual mortality of 38.8 per cent for does, 22 per cent for young rabbits, and 17 per cent for bucks.

Heavy mortality is perhaps the most important factor in regulating production per doe. The very decided increase in the pounds raised per doe noticed in recent years indicates that diseases are now more successfully controlled.

Coccidiosis, snuffles, bloat disease, and failure to breed usually cause the greatest loss. Diarrhea, pot-belly, slobbers, and similar ailments should usually be considered symptoms rather than specific diseases. Any great loss of baby rabbits will probably be caused by wrong feeding, wrong breeding, poor housing, or unfavorable climatic conditions, such as excessive heat.

If you are a beginner, ask someone who recognizes healthy animals to help you select your breeding stock. Then by proper care and management you will be able to keep the rabbits practically free from disease. New stock introduced into the rabbitry is one of the greatest sources of disease. Buy only healthy, vigorous animals and keep them apart until a clean bill of health is established. This will prevent the spread of such troubles as coccidiosis, worms, and ear canker. These diseases and parasites need not cause serious loss if isolation and sanitation are practiced; but careless handling can make the rabbit business decidedly unprofitable.

**Giving Medicine.** Powder is the best form in which to give medicine internally. Stand the rabbit on a table or a bench, on a rabbit pelt or piece of burlap or carpet spread to keep the fur from being soiled or injured. Gently grasp the animal by the back of the neck with one hand

and place the other hand on its hips. Turn it on its back and place the right arm over the hindquarters to keep it from kicking. If a rabbit has never been handled in this manner it may object, but patiently quiet it and turn it over. With the rabbit's nose turned upward, gently press the jaws apart with thumb and forefinger, and place the powdered medicine well back on the tongue. Capsules—for instance, castor oil—can be given by the same method.

Liquid castor oil—or any other liquid medicine—can be given through a rubber tube, but only if the operator is experienced; a beginner should use a break-proof medicine dropper. This method of giving liquids permits the rabbit to swallow the dose in small amounts.

Apply liquid medicine to the nostrils with a small oil can. Hold the rabbit in the same position as for internal medicine and gently squirt the required amount of liquid medicine well up into the opened nostrils. Then quickly stand the rabbit on its feet to catch its breath and keep the liquid from getting into its lungs. **Liquid must never run into the rabbit's lungs.** A breakproof medicine dropper can also be used to place medicine in the nostrils or eyes.

**Quackery in Rabbit Medicines.** The large profit in the sale of patent medicines has produced many worthless rabbit treatments. The State Food and Drug Laboratory cannot legally prevent the sale of a medicine—no matter how worthless or harmful it is—if the package does not bear a claim that the material will cure. Treatments can therefore easily be sold for diseases that are now considered incurable. Rabbit raisers should understand this danger in order to discourage the sale of worthless patent medicines. Consult a competent veterinarian if there is any doubt about the disease or the treatment.

## Infectious Diseases

### Coccidiosis

Recently at least two different microscopic animal parasites have been fairly definitely proved responsible for the different forms of coccidiosis. One causes the intestinal form of the disease; the other, the liver form.

So far as is now known, there is no danger of any animal, other than the rabbit, spreading rabbit coccidiosis. *Eimeria* parasites are apparently limited to herbivorous animals, and the species attacking rabbits do not normally attack other animals. Operators should keep in touch with the latest recommendations of the United States Rabbit Experiment Station at Fontana, or of others, on the progress being made in study of this disease.

**Intestinal coccidiosis** is now associated with the parasite *Eimeria perforans* Leuc. This form may cause death of young rabbits in 6 to 15 days, especially of rabbits 6 weeks to 2 months old. It probably causes 95 per cent of the mortality in rabbitries; in a large rabbitry, mortality may run from a few to several hundred animals within a short time. This form seems to cause death more quickly than the liver form.

Four intestinal species of coccidiosis organisms are known, and other forms as yet undescribed are being studied. In California there is a reasonably high tolerance, although not equally high, to all four. A rabbit raiser must understand the nature of this disease to distinguish it from mucoid enteritis or any similar condition with which coccidiosis is confused.

**Symptoms.** Intestinal coccidiosis may show no outward symptom in its early stages. In its advanced stage the rabbit has poor appetite, dull fur, lacks energy, loses weight, may drool, and may have abdominal dropsy. Diarrhea may be present. Many young rabbits die in convulsions. Post-mortem examination may show small bloodshot areas about

the size of a pin point or pin head on the inner coat of the intestines. The blood and flesh may be pale and watery.

**Treatment.** No treatment has been found effective in control.

**Preventive Measures.** The egg capsules of coccidiosis incubate in manure. Three or four days are usually necessary for the egg to develop into infective form. If the manure is removed before the parasite reaches an infective stage, and the operator keeps feed or water from being contaminated, healthy young rabbits stand a good chance of escaping infection. Older rabbits are even less susceptible under sanitary conditions.

Any feed coming in contact with infective manure should be destroyed, and any hutch or carrier exposed should not be used again until it is thoroughly disinfected. This is one of the important reasons why all hutches should be self-cleaning and should be kept dry and sanitary at all times.

**Liver coccidiosis** is caused by the parasite *Eimeria stiedae* Lind. The raised white areas found on the liver are responsible for the common name of the disease "spotted liver." This form is often chronic with a doe which, although not visibly sick, is capable of spreading the disease to her young.

**Symptoms.** There may be no outward indication of spotted liver in some young rabbits attacked by the disease. Not until the animal is dressed for eating will the white spots be detected. Presence of these spots indicates a mild chronic case. Rabbits carrying the disease in chronic form may not make the best gains. In severe cases young rabbits may die.

**Treatment.** No treatment has been effective.

**Preventive Measures.** The preventive measures used for intestinal coccidiosis are also used for the liver form.

**Nasal coccidiosis** is sometimes mentioned in rabbit literature, but many au-

thorities now believe that the presence of coccidia in the nasal passage is not a cause of coccidiosis but the result of inhaling the fumes of infective manure in unclean hutches.

### **Eye Trouble (Blindness of Young)**

Eye trouble is usually due to infection and is treated accordingly. The adults may have runny eyes; the young, swollen eyelids with red pimples sometimes at the edges. Young animals may become totally blind. Eye trouble usually occurs in filthy hutches where the air is contaminated by injurious gases from manure.

**Treatment.** Wash the eyes of affected animals with boric acid—1 tablespoon of powdered boric acid to 1 pint of water. Boric acid dissolves best in hot water, but the solution should be cooled before it is used. Iodoform ointment may be used for discharging sores that may develop.

Eyedrops prescribed for infections with human beings, such as 25 per cent argyrol, are considered safe for rabbits.

**Xerophthalmia** is another form of eye trouble. It is caused by vitamin-A deficiency (see "Vitamins," p. 31).

### **Favus (Ringworm)**

A vegetable parasite causes favus. Rabbits up to 3 months of age are especially susceptible. Older rabbits, which are carriers of the disease, are quite resistant, although some of them will have a few small skin lesions. This disease is most commonly brought into a rabbitry by new rabbits. It can also be transmitted from caretaker to animals or from animals to caretaker.

**Symptoms.** The parts most often infected are the nose, the area around the ears, the legs, and the paws. There may be from 1 to 30 lesions; these vary in size from that of a pin head to a dime. They are very typical, occurring as depressed cups covered with a yellow crust which, in old lesions, becomes grayish. If the crust is removed, the cuplike de-

pression appears to be covered with a grayish powder. The hair on the lesions breaks off, grayed and split, and the lesions, which give off a mousy odor, are left bare.

**Treatment.** There is no treatment for favus. It is always best to kill the infected animals and burn them or bury them deep.

**Preventive Measures.** Methods of control depend on the extent of the infection. After killing the animals and disposing of them, use a torch and burn all loose hair about the hutches in which they were housed. Thoroughly scrub and disinfect the entire hutch, all feed and water containers, and toilets. Closely check the remaining rabbits to detect any new outbreaks of the disease.

### **Infectious Myxomatosis (Mosquito Disease)**

In parts of southern California in 1930 there were several cases of an infectious virus disease now commonly known as mosquito disease. This disease has appeared in various parts of the state with high mortality. In the 1930 outbreak all rabbits attacked died. Attempts to immunize were unsuccessful. Since then some rabbits have been known to recover without previous vaccination. Others have shown partial resistance. Reports (Fisk and Kessel, 1931; Vail, 1943; Kessel *et al.*, 1931) indicate that recovery from either the California type of myxomatosis or the South American type will render immunity to subsequent inoculations with both strains of the virus.

**Symptoms.** The first symptoms are a swelling in the regions of the nose, lips, and genitals. The ears thicken and usually droop. The membrane of the eyelids is also inflamed. The pus developing in nose and eyes discharges and spreads the disease. If a rabbit lives longer than a week or 10 days after showing the first symptoms, nodules will develop around its eyes, nose, or on the ears. An autopsy usually discloses an enlargement of the lymph nodes and the spleen.

## **Pasteurellosis**

The various forms of Pasteurellosis include snuffles (nasal catarrh), abscesses or boils, acute septicemia (similar to hemorrhagic septicemia of farm animals), and another form which attacks the genital tract. Pasteurellosis was once known principally as "snuffles," but the other forms are caused by the same organism—*Pasteurella multocida* (*P. cuniculicida*). Two types of the *Pasteurella* organism are now listed—*P. multocida* and *P. hemolytica*—but the strains of *P. multocida* only are pathogenic to rabbits.

**Snuffles or Nasal Pasteurellosis** produces symptoms similar to the symptoms of a bad cold. Conditions favoring a cold may also favor Pasteurellosis, but where a cold is usually a temporary condition, snuffles Pasteurellosis usually grows progressively worse. The ordinary cold form of the disease may not be fatal, but the more advanced stages will leave the animal of little or no value as a breeder. The presence of "sneezers" in a rabbitry is always noticed by prospective buyers. Some animals affected with a mild nasal form apparently recover, yet remain carriers of the disease.

**Symptoms.** In the nasal form the rabbit usually sneezes. At first the nostrils are a little more moist than usual; then a thin, watery discharge begins. Next, snuffling or coughing develops and the discharge from the nostrils becomes thicker. The rabbit may wipe its nose on its forepaws, soiling and matting the fur. The passageway from eyes to nostrils may become clogged and cause water to run down the cheeks from the corners of the eyes. Drooling is also a symptom.

**Treatment.** There is no known cure for any form of Pasteurellosis. A mixed infection bacterin (Lepin) has been used to treat the snuffles form, but it did not offer satisfactory protection, and its use is not recommended by some veterinarians. The person who attempts any kind of treatment should protect his clothing and disinfect his hands afterward.

If the eyes are affected, treat as prescribed for mild forms of eye trouble in the section on "Eye Troubles," page 42.

**Abscesses or boils** sometimes develop from Pasteurellosis. These may occur on any part of the body. Lanced abscesses will discharge thick yellow pus; encapsulated abscesses may be found within the body cavity in autopsy. If treatment is attempted, lance and drain the abscess as discussed under "Boils and Abscesses," on page 44. Protect the clothing and thoroughly disinfect the hands afterward.

**Acute septicemia** occurs occasionally. This form of Pasteurellosis closely resembles hemorrhagic septicemia of farm animals. It is usually fatal, causing death in 24 to 48 hours. Autopsy shows the lungs to be congested, with inflammation often extending into the trachea. A greatly enlarged spleen and small hemorrhagic areas under the skin are also symptoms.

**Genital Pasteurellosis** is a form of the disease which attacks the genital tract of adult breeding rabbits. The danger is in spread of the organisms in mating. This form may become acute or it may linger in a chronic state (see also "Vent Disease," p. 44).

No treatment for either the septicemic or the genital-organ form of Pasteurellosis should be attempted.

**Preventive Measures.** In all forms of Pasteurellosis segregate suspected carriers. If only a few rabbits are affected, it is better to destroy them than to attempt treatment. If many are affected, segregate the suspected carriers, and quarantine the sick until they can be disposed of. Burn or deeply bury the carcasses.

Scrub and disinfect the entire inside of each hutch. Clean and disinfect all food and water containers and toilets. Destroy the contents of each nest, then clean and disinfect the nest box.

The most important preventive measure in all forms of Pasteurellosis is for rabbit raisers to select breeders very carefully, then maintain the strictest possible

sanitation in the rabbitry. Never interchange feed or water containers in the hutches and never allow damp or chilly conditions to exist at any time.

### **Pseudotuberculosis**

Nodules or tubercles sometimes seen in lungs, liver, the intestinal tube, and spleen, similar to those in tuberculosis, may indicate an infectious disease known as streptobacillary pseudotuberculosis. This disease, which attacks rabbits only occasionally, is caused by a specific germ, *Corynebacterium rodentium*. Death usually follows close upon the symptoms.

**Symptoms.** Weakness, emaciation, lack of appetite, and labored breathing are the usual symptoms.

**Treatment.** No treatment is recommended. Kill the animals and thoroughly clean and disinfect the quarters, feed and water containers, toilet pans, and any nests being used at the time.

### **Rabbit Fever (Tularemia)**

This disease is mentioned here only to assure rabbit raisers and consumers that the domestic rabbit is in practically no danger of contracting it. Rabbit fever is a serious bacterial disease of wild rabbits and certain other wild animals, but no case among domestic rabbits appears in the most recent report on the disease. Great care should be used in handling wild rabbits suspected of the disease.

**Snuffles** is the name applied to one form of Pasteurellosis (see p. 43).

### **Vent Disease (Urine Burn, Hutch Burn)**

If the delicate membrane near the sex organ or the anal opening becomes chapped, any one of several skin bacteria may cause infection. Since one form of infection, at least, may be fatal (see "Genital Pasteurellosis," p. 43), it is necessary to distinguish between cases with and without the spirochete associated with infectious vent disease.

**Symptoms.** The delicate membrane near the sex organ and sometimes the anal opening are inflamed. Yellowish or brownish crusts may cover these parts, with swelling, cracking, bleeding, or possibly the discharge of pus. The glandular pockets on either side of the vent, which normally contain a moderate amount of thick whitish secretion, may also be affected. In mild cases, if housing conditions are at fault and are corrected, treatment may not be necessary.

**Treatment.** Rub lanolin well into the affected area 4 or 5 times a day. In more severe cases, treat the parts daily for 4 or 5 days with a mixture of 1 part calomel and 3 parts lanolin. After that, if further treatment is necessary, apply lanolin only for a few days.

**Preventive Measures.** Keep the hutch floor dry and clean. Give the corners special attention; if they are neglected, urine burn may develop when urine splashes back upon the rabbit. Solid rails will also cause splash-back; they should not be used in the hutches. If part of the floor is solid, be sure to keep it clean. Change the bedding frequently.

## **Noninfectious Diseases**

### **Boils and Abscesses**

Lumps or abscesses sometimes appear on different parts of the rabbit's body. Boils on wild rabbits are caused by the larvae of an insect, but most of the boils on domestic rabbits are caused by bruises, by some toxic condition or some infection, such as *Pasteurella* organisms (p.

43), or possibly by the many-headed bladder worm (p. 46). Some authorities consider susceptibility to boils inheritable, but, so far as is known, no organism that would cause abscesses is carried over from one generation to another. Since treatment involves considerable labor and

some expense only the more valuable animals will justify care.

**Symptoms.** Boils may come to a head or they may remain as a swelling beneath the skin for some time. If the boil is filled with pus, disinfect the surface with Merthiolate or fresh tincture of iodine, lance the abscessed tissue, express the pus, and swab the cavity with fresh tincture of iodine. Repeat this treatment as long as pus forms. Healing must start from inside the cavity of the wound for recovery.

**Preventive Measures.** Sanitation, dry and comfortable quarters, and proper feed, which will aid in building up a natural resistance to disease, are the most promising aids in permanently overcoming such troubles.

#### **Mucoid Enteritis (Bloat Disease)**

This disease is usually considered a digestive disorder. It is apparently not caused by any organism. It may be confused with intestinal coccidiosis because of accompanying diarrhea, but the presence of mucus in the droppings helps to identify it.

Mucoid enteritis affects rabbits of all ages, but most often those under 18 months. Young rabbits of 5 to 8 weeks may die within 24 to 72 hours. In older animals the disorder lasts longer, but with less mortality. The exact cause has not yet been determined since the disease has not been produced at will by any known experiment.

**Symptoms.** The affected animal first shows lack of appetite. Its eyes are lusterless and its coat dull. Internal pain causes it to grind its teeth. It often shows intense thirst by sitting at the water container and drinking frequently. In time the abdomen becomes distended or bloated. Either constipation or diarrhea may accompany the disorder with mucus voided with the droppings in a high percentage of cases. Autopsy may disclose lesions in the intestines.

**Treatment.** Remove feed and water for about 48 hours, then offer small

amounts of fresh green feed. After the fourth day give water once a day in addition to green feed. Leave the water before the rabbit for only a few minutes, then remove the container to keep the animal from drinking too much. Limiting the water intake will help to prevent a recurrence. After about 8 days, feed a small quantity of good-quality alfalfa hay, but be careful not to overfeed. Add grain a few days later, and gradually increase the amount until the rabbit is again on full feed.

**Preventive Measures.** Apparently there are no special preventive measures with this disorder.

#### **Rabbit Mange or Ear Canker (Scabies)**

Ear canker develops during an infestation of the rabbit-ear mange mite. Treated in its early stages it is easily cured. If the mites reach the inner ear, however, pus may form and ultimately kill the rabbit. There are mange mites other than the one causing ear canker, but usually these are not serious in California. All are controlled by the same treatment. Ear canker will disqualify a rabbit for show.

**Symptoms.** In the early stages, a crust forms inside the ear, and the mange mites are located beneath it. In a case of wry neck, first look for ear canker. Both wry neck and twisting or shaking of the head to one side may indicate an advanced stage of ear canker.

**Treatment.** Very gently remove the exuded matter and brown crumbly crusts, resulting from the irritation, with a slender blunt-ended piece of wood—about the size of an orange-wood stick—or a cotton-tipped swab stick. Do not add to the irritation by scraping the tender membrane. After cleaning the ears, apply with a swab or soft brush an antiseptic lotion, such as: 1) 1 part iodoform, 10 parts ether, and 25 parts olive oil; or 2) 0.4 ounce carbon tetrachloride to 1 pint vegetable oil or glycerine. Repeat the application in 6 to 10 days.

## **Skin Troubles and Insect Pests**

If rabbits are attacked by fleas or other skin parasites, dust the skin with an insect powder, such as rotenone or pyrethrum. Rub the powder well over the skin. **Do not use DDT dust!** It is a poison which rabbits will swallow as they lick themselves. Where skin troubles are parasitic, treat the animal as recommended for mange mite on page 45.

**Preventive Measures.** As a part of the control of skin parasites, clean and disinfect the hutches thoroughly with lye water or with a torch to destroy any possible breeding places of the parasites. Give fresh bedding and, if necessary, fresh straw in the nests.

## **Slobbers**

Some producers consider slobbers a form of indigestion caused by excessive amounts of green feed or green feed to which young rabbits are not accustomed. Since drooling may also be a symptom of either snuffles (see p. 43) or coccidiosis (see p. 41), be certain that indigestion is the cause.

**Treatment.** If indigestion is the cause, regulate the diet as outlined under feeding (p. 30), with more bulk in the form of wheat bran to help prevent impaction and indigestion. Any change in the diet should be made gradually.

## **Worms**

Roundworms, tapeworms, and similar pests are not common in a dry, clean rab-

bitry. Roundworms are expelled in the feces and infect the feed on the hutch floor.

The **tapeworm** (*Taenia pisiformis*) has the dog and, less commonly, the cat for primary hosts. The **many-headed bladder worm** is a kind of tapeworm which enters the body with infected feed. The parasite usually locates in the muscles and under the skin, but it sometimes centers in the heart, lungs, and elsewhere in the body. Cysts may form and range in size from that of a pea to an apple. The dog is an intermediate host to the many-headed bladder worm also. **Another form of bladder worm** attacking the domestic rabbit may be one of the causes of pot-belly, although pot-belly (p. 48) is more often caused by coccidiosis, bloat disease, and indigestion.

**Treatment.** These worms are so uncommon in a sanitary rabbitry that a discussion of treatment is not warranted. The advice of a veterinarian should be sought if they become a problem.

If large cysts form and treatment is attempted, lance the affected area as you would abscesses (see p. 44), drain, and disinfect with fresh tincture of iodine.

**Preventive Measures.** Keep the hutches dry and clean. Keep dogs and cats away from the premises of the rabbitry, and do not permit them to sleep on sacks of rabbit feed.

## **MISCELLANEOUS PROBLEMS**

### **Cannibalism**

Some does kill and eat their young. This tendency is found most often among young mothers, especially those bred too young. This has been attributed to extreme nervousness, thirst, or an unbalanced ration—especially one insufficient in protein. This may also occur if a doe is a poor breeder or is overly fat. Dispose of does that continue to give trouble after precautions are taken.

Rats sometimes eat small rabbits. Trap or poison the rats, but if poison is used, be very careful that it does not come in contact with the rabbits or the feed.

**Preventive Measures.** Rations too low in protein may be improved by adding a good protein supplement and green feed (see p. 37). Salt has been supplied with very good results to poultry to overcome cannibalism.

At kindling, when cannibalism might

follow, give plenty of fresh cool water. Let the doe strictly alone and do not examine the young too soon after birth. If they must be examined, place the mother in another hutch until examination is over.

### **Constipation**

This usually occurs when too much dry feed is given, although it sometimes accompanies mucoid enteritis (see p. 45). To help prevent constipation, give 2 ounces of green feed daily to adult rabbits and about 1 ounce daily to weaned rabbits. In extreme cases give castor oil as suggested for pot-belly (p. 48).

### **Diarrhea (Scours)**

This is a rather common ailment among young rabbits, sometimes with heavy mortality. It may be the symptom of a serious digestive upset caused by infection or by undigested feed in the intestinal tract, which has been attacked by various bacteria. Other possible causes may be excessive quantities of damp greens, feed containing poisonous weeds, musty hay or grain, too early weaning, any condition that lowers the vitality, such as vitamin-A deficiency, unsanitary hutches; or it may be a serious disease, such as coccidiosis or mucoid enteritis. Coccidiosis, mucoid enteritis, and irregular feeding of large amounts of greens to young rabbits are the most common causes. Very young rabbits stricken seldom warrant treatment.

**Treatment.** Remove the affected rabbit to a separate hutch. Reduce the amount of green feed and try to persuade the rabbit to take scalded milk. A mash of bread in scalded milk is very good. Avoid excessive use of wheat or wheat bran, which contains a laxative protein.

If coccidiosis is the cause, refer to the section on coccidiosis on page 41. If bloat disease is involved, remove all feed and water for a time, as discussed under "Mucoid Enteritis" on page 45. If the cause is poisoning, immediately give 1 to

2 teaspoons of castor oil to empty the small intestine and quickly rid the body of the poison. Withholding feed for a short time after the dosage of castor oil may also help.

If the cause is simple indigestion use 3 to 6 grains of bismuth subnitrate twice a day; or 5 to 10 grains of ordinary baking soda (bicarbonate of soda) in a teaspoon of water twice a day.

**Preventive Measures.** Feed to avoid constipation. See that the ration does not contain poisonous weeds, musty hay or grain, or excessive amounts of damp greens. Avoid any deficiency, such as vitamin-A deficiency, that would lower the vitality. Keep the hutches and hutch equipment dry and clean.

### **Failure to Breed**

This is discussed under the section "Breeding," on page 20.

### **Infant Mortality and Abortion**

If a doe aborts, or if the young appear almost lifeless at birth or die without any noticeable cause soon after birth, weak and unhealthy parents are usually the cause. The doe may have been bred too often or allowed to raise too many young. The buck may have been too young for breeding or allowed to serve too frequently to secure strong offspring.

Another possible cause of infant death may be insufficient milk. A young doe sometimes has difficulty in nursing. She may have tender or sore nipples or caked udders. If so she will tend to scatter the young whenever they begin to nurse. Examine the nipples to see if they are sore; if so, treat them with lanolin. If her condition is normal, hold her until she can become accustomed to nursing. This may overcome the difficulty, but if she persists in refusing the young, or if she scatters them about the hutch, it will be best to get rid of her.

A doe suffering from sore hocks (see p. 48) also will not properly nurse her young.

## **Molting (Shedding)**

Although molting is not a disease, special care is needed during the first molt, which comes at about 6 to 8 weeks of age. Give the rabbits plenty of well-balanced feed, with a small amount of protein added to help form a good coat. Many breeders add whole flaxseed to the ration at time of molt. A molting rabbit is not in proper physical condition to be bred.

## **Paralysis and Leg Weakness**

Paralysis usually attacks the hindquarters and causes the rabbit to move with great difficulty. Several conditions may cause both paralysis and leg weakness: injury when rushing about the hutch if frightened by dogs, cats, or other predatory animals; too frequent breeding, or nursing too large a litter; and infection at time of kindling, when the nerve centers controlling the muscles of the hindquarters are hopelessly affected.

Leg weakness or rickets in young rabbits is caused by deficient calcium assimilation. Where a ration is so deficient in vitamin B<sub>1</sub> that paralysis results, the trouble can be quickly overcome by feeding adequate amounts of whole grain, especially the germ part of the grain, and by feeding only high-grade alfalfa hay which contains a small amount of this vitamin. In an emergency add high-grade yeast to supply vitamin B<sub>1</sub>.

## **Pot-belly**

This trouble is found primarily among the young. It may be caused by too much damp or wet green feed or by musty hay and grain. Too much crude fiber in the ration may also be a cause. If the young are weaned too soon, they may be unable to digest the bulkier feed and excessive amounts of greens. In all of these cases the abdomen becomes swollen and pendent. If intestinal coccidiosis is suspected, see page 41.

**Treatment.** Reduce the amount of feed if necessary. Give affected rabbits

1 to 2 teaspoons of castor oil, according to their size and age (see p. 40). In mild cases place a few drops of castor oil in the feed. **Do not give wet or musty feed or damp or wet greens.**

See that the rabbits have plenty of exercise. This calls for a hutch large enough so that they may move about easily.

## **Sore Hocks**

If a rabbit's hocks become bruised or chafed, they may become infected. The pain which follows is intense. Rabbits, especially those of nervous temperament, often tread or stamp with the hind feet even while sitting. If moisture, urine, and filth are allowed to collect in a hutch, the footpads will soon become infected. Rabbits with dense and long fur on the footpads are most subject to sore hocks. A doe so affected will not properly nurse her young. The life of breeding animals will be shortened.

**Symptoms.** The rabbit will rest in a position to relieve the injured parts of the hind feet. Inflamed or ulcerated areas may appear on the underside of the hind feet and bruised places—possibly on the pads and toes of the forefeet. In time the rabbit will lose flesh through suffering. In advanced stages the hair over the injured parts may fall out, and a scaly crust may develop. Sometimes this is accompanied by bleeding. Pus may then form in the swollen area, sometimes draining without lancing.

**Treatment.** Treat the affected parts with zinc or iodine ointment every other day until healing is well advanced. Keep the hutch floor scrupulously clean. Bed solid floors with clean straw, and place a lath platform over a wire floor to ease the sore parts.

**Preventive Measures.** Select rabbits of quiet disposition to replace high-strung animals. Prevent any disturbances by natural enemies of the rabbit, such as the dog, cat, snake, and opossum. Avoid feeding young rabbits beyond the weaning age too heavily on concentrate feed

which would cause excessive weight and greater susceptibility to hock injury.

Keep the hutch, hutch equipment, bedding, and nests dry and clean at all times.

### Sudden Deaths

Beginning operators especially may have some trouble determining the cause of sudden deaths. When several animals die suddenly at the same time the cause may be excessive heat or feed that is too coarse or possibly poisonous. Carefully check all conditions in the rabbitry to determine the cause and to correct it.

### Wounds

Clean wounds with warm water and pure soap, then treat with a disinfectant. In severe cases, where the skin has been torn, clean the wound and treat with 2 per cent Merthiolate or 2 per cent fresh tincture of iodine. With a sterilized needle and sterilized fine silk thread, take as many stitches as are necessary to bring the edges of the wound together. Tie each stitch separately, and leave threads long enough to find easily and remove about a week later. Keep the wound disinfected until healing starts.

## MARKETING ORGANIZATIONS

Many operators are successfully raising rabbits, but not all are marketing to advantage. Probably the most important reasons for this are the producer's lack of time and his lack of coöperation with other producers. True, some producers have actively tried to improve marketing conditions through their local producers' association, but better facilities are still needed in most areas.

A large producer devotes his entire time to production and must, of necessity, turn his marketing over to a hired agent, or buyer. This means that he does not have direct contact with the markets. As production exceeds local demand, he must go outside his district to equalize supply and demand, but he is too busy as an operator to establish these markets himself. Rabbits have usually been marketed on a locality rather than on a commodity basis. The operator has therefore often suffered low prices simply because he did not have the time to extend his market beyond his locality, and because there was no organization, or he had not associated himself with an organization, which could perform this service for him. The producer must have a dependable market or he will fail.

The buyer of rabbit products is also vitally concerned with the development of a dependable market. Producer and

buyer are dependent upon each other for adequate production and successful sales, and both are dependent upon the selling organization.

Any selling organization, in turn, must be assured of a dependable supply before making a selling contract with a buyer. An estimate on supply, however, has been difficult to get because coöperation among producers has been lacking. The organization best qualified to estimate supply is a group of rabbit breeders, but until producers are willing to work together, lack of coöperation in furnishing an estimate on supply will cause prices to fluctuate and markets to be uncertain. High winter prices will still tend to reduce consumption; and lower summer prices, to reduce production.

**Producers' Associations.** Producers should work together to improve the marketing conditions in all branches—for instance, in both meat and fur, where present market demands are large enough to take care of a fairly heavy production. True, the sale of meat may depend on appetites and the sale of fur on styles, but markets can still be developed which will warrant a considerable increase in both lines of production. The Rabbit Meat Producers' Association in the San Gabriel Valley in Los Angeles County has operated with considerable success.

In an association program avoid duplicated effort, both in setting standards and in selling. Duplicated effort in any type of organization is usually unsatisfactory. An example in the rabbit industry was the California Rabbit Butchers' Association where, in one southern city, 15 wholesale butchers handled more than 500 rabbits weekly and 50 more wholesale butchers handled from 50 to 500 weekly. One national, one state, and one local rabbit producers' association are all that can function satisfactorily.

**Coöperatives.** Many of the successful branches of agriculture are now based on individual production and collective marketing and financing. According to recent studies of coöperating marketing, control of supply and ability to dictate prices are not essential to the operation of such an organization. A coöperative should comprise only those producers who believe in coöperative marketing.

There is no reason why the production and marketing of rabbits should not be coöperative. There is a trend in that direction in Los Angeles County where 3 marketing coöperatives are active. Any trivial differences occurring among producers should be worked out. In the building up of regular supply and demand through such an organization, the serious fluctuations and losses to producers would be eliminated. Consumers would also benefit by coöperative marketing.

## PREPARING MEAT, PELTS AND FURS, AND WOOL FOR MARKET

The preparation of rabbit products for market requires a great deal of skill. A producer needs to learn the special techniques and to know what methods should not be used. For instance, in the preparation of rabbit meat one method should be discouraged by producers. This method,

A number of California coöperatives are selling branded products with excellent results. A well-graded product of high quality put out under a reputable association brand will in time reflect to the credit of all members. For example, a dry pack of well-graded, high-quality rabbit meat, possibly sold in attractive cut-out cartons under the coöperative's brand should appeal to buyers wanting a fine product. The big problem of surplus may be partly met through this outlet.

Some rabbit producers must be interested in organizing coöperative marketing associations. Considerable information on the subject has been collected by the College of Agriculture of the University of California for use as a guide in such an undertaking.

Producers outside the coöperative will probably benefit very little from the organization's services and brand, but, in time, some may see the need of coöperating. Other producers can work through selling firms, realizing, of course, that they will usually be forced to take whatever prices are offered. Still others may contribute to the pooling of the output in a district and selling through reputable buyers, a plan which has been fairly successful, especially in that it avoids the high investment involved in packing privately.

called hog-dressing, is used on imported rabbits which are already drawn upon arrival. The abdomen is open, but the pelt remains to prevent the meat from turning dark in storage. This method offends customers who have a sentimental regard for rabbits.

### Meat

**Killing.** Hold the animal on a bench or a table and stun it with a quick blow behind the ears. Use a small heavy stick

or a small iron bar. Immediately after stunning, cut the jugular vein in the throat with a sharp knife to bleed the animal;

then fasten the carcass to a line nail or a hook to complete the bleeding. A special gambrel is sold for hanging rabbits during dressing, but a homemade one will serve just as well. Hooks fastened to a strip of wood will also serve (fig. 22).

**Dressing.** An experienced rabbit butcher can easily dress from 60 to 100 or more rabbits per hour if a helper brings the animals in and handles the removed pelt. After removing the pelt (see page 52) slit the carcass down the abdomen, starting near the tail. Cut around the anal opening and through the juncture of the pelvic bones; then, with a gentle backward bend of the legs, pry apart the hindquarter to expose the lower intestine. Follow on down the abdomen with the knife and remove the entrails, but leave the liver and the kidneys embedded in the fat along the back. Remove the stomach and lungs, and sever the feet with pruning shears. Wash the carcass if necessary, then dry and cool it until the body heat is gone (fig. 23). **Never chill the dressed rabbit until the body heat is entirely gone.** Some dressing establishments throw the carcass into cold water and, after it has cooled, pack it in ice. If a carcass is soaked in cold water, it should remain only long enough to be cooled.

For local trade the ribs may be broken to flatten the chest and make the animal look less lifelike. A few sprigs of parsley and a neat wrapping of oil paper or cellophane will make a dressed rabbit look very appetizing. Special cartons are sometimes used to display rabbit meat cut up for cooking. In the cut-out areas in the top the best cuts are placed to attract the retailer customer.



Fig. 22. Upper: Carcasses may be hung on hooks to complete bleeding.

Fig. 23. Below: Properly dressed, clean rabbits bring top market prices.

## Pelts and Furs

Pelts can be saved almost as easily as they can be discarded. The pelts should be saved from all rabbits dressed at home. Even those on the rabbits sold alive to dressing plants can be saved and returned to the producer if the buyer is induced to coöperate for a certain allowance.

### Grading

The larger fur dealers usually have about 6 grades, based primarily on color, condition, and size. Certain colors, such as white, Chinchilla, Havana, and Lilac are very popular. The fur producer should become acquainted with the best color for the breed concerned. Condition involves fur quality, molt, and pelt treatment. The characteristics of the 6 fur grades sometimes used commercially are shown in table 6. Standards for grading rabbit fur are now being sought.

The highest prices are paid for large pelts with soft dense fur 1 to 1½ inches long. The color of the fur should be uniform and the pelt free from hutch and blood stains, sun injury, and molt. The pelt must be taken at the right time and properly handled to meet all of these requirements. Poorly dried, wormy, torn, or soiled pelts are practically valueless. The simple fact that the pelt is from a Chinchilla, a Havana, a Lilac, or one of the popular white breeds is no indication that it will bring any more than butcher-run prices if these requirements are not met.

**Fur Quality.** The quality of the hair is very important. A pelt with coarse, stiff,

dull hair has little value. This condition may be caused by too much barley, milo, or corn in the feed, or it may come from faulty breeding. In summer, pelts tend to be thin haired. In the cooler months, high quality is more easily secured. Dense fur at that time will have up to 50,000 hairs per square inch. In the winter months fur prices are usually best.

Molt can quickly lower the value of the finest pelt. It is usually indicated by a break in the ticking (guard hairs); if the pelt does not show ticking, gently pull the fur near the rump to see if there are loose hairs. Blowing into the hair may disclose new hairs at the base near the skin, which would indicate molt. A dark discoloration of the skin before or after dressing is also an indication of molt.

The first molt starts when the rabbit is 6 to 8 weeks old. Young meat rabbits between 2 and 3 months may have fair pelt quality during the winter. The pelt should then be in good condition again when the rabbit is about 5½ to 6 months old. The best pelts are usually taken from rabbits approaching 6 months of age between October and April.

### Pelt Treatment

**Skinning.** If the pelts are to be saved for the market, slit the animal down the inside of the legs and around the neck with a small knife. Then peel the pelt down over the legs and hindquarters, starting at the hock joint and stripping from the body, leaving the flesh side out. Use a knife, where needed, to separate

Table 6. FUR GRADES

Item	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Color . . . . .	Perfect	Perfect	Fair	Perfect	Perfect	Hatters'
Size . . . . .	Large	Large	Large	Large	Small	
Hair . . . . .	Dense and soft	Dense and coarse	Dense and soft	Unprime	Dense and soft	

the skin from the flesh and fat, especially along the abdomen. Cased skins (fig. 24) are very easily removed and treated, and are preferred on the market. Skins slit down the front are salable but are not so desirable. They are much harder to stretch for drying.

**Stretching.** Special wire stretchers are sold for stretching cased skins during the drying process. Wire stretchers can easily be made with 8- to 10-gauge galvanized wire, preferably without a loop at the top (fig. 24). A board can be used instead of wire, but drying is slower. All four legs should be placed on one side of the stretcher and the back of the pelt on the other side. Clothespins may be used to hold the pelt in place on the stretcher.

**Tanning.** The general rabbit producer is neither equipped nor trained to tan rabbit pelts properly. Pelts to be sold therefore should not be tanned before shipment. Only those pelts intended for home use should be tanned.

For tanning, slit the cased skin down the belly and soak it in several changes of clean cold water for 2 or 3 hours. Longer soaking may loosen the hair. As soon as the skin is softened, spread it over a rounded stretching board or pole and remove all adhering tissue, flesh, and fat with a file or a dull knife. This treatment also aids in working out the grease and oil.

When the skin is softened and clean, work it further, this time in lukewarm water containing 1 ounce of baking soda or borax to each gallon of water and  $\frac{1}{4}$  ounce of powdered soap. Rinse the skin thoroughly in lukewarm water and gently press out the water. Next, work it in high-grade gasoline to remove the last particles of dirt and grease. Be careful about fire while using the gasoline. When the gasoline has evaporated, the skin is ready for tanning.

Two methods of tanning are used for rabbit skins—the salt-acid process and the salt-alum process. The salt-alum process



Fig. 24. Fur stretchers made of #8-gauge galvanized wire keep pelts stretched tight until dry.

may require a little more working than the salt-acid process to make the skin soft and pliable, but it is considered a somewhat more satisfactory process.

**The salt-acid process** calls for a solution of 1 pound of common salt and  $\frac{1}{2}$  ounce of concentrated sulfuric acid to each gallon of warm water. First dissolve the salt, then gradually pour the acid **into** the salt water, stirring constantly.

**Never pour the salt solution into the acid!** Use a container made of glass, clay, or wood, but not metal, which could be eaten by the acid. **Do not inhale the fumes nor spill any of the liquid on skin or clothing while it is warm.** When the solution has cooled, it is ready to use.

Leave the skin in the solution until it is entirely covered. This will take 1 to 3 days. Stir the solution frequently to insure even treatment of the pelt. Finally, remove the pelt and rinse it in clean cool water. Work it then for about 10 minutes in a solution containing 1 ounce of borax dis-

solved in a gallon of water. Rinse the pelt again in clean water and press it as dry as possible without a wringing movement. Rub and pull it for a few minutes by hand, then tack it flat, flesh side up. Apply to it a thin coating of fresh butter, neat's-foot oil, or olive oil. Cover the paste lightly with paper or burlap to prevent rapid drying. Let this stay on the skin until it is dry.

While the skin is still slightly damp, begin to work it by hand, stretching and pulling it back and forth over the stretching board or pole. If the skin is rough, work it over a sandpaper block until it is soft and pliable. Good tanning is dependent on a thorough working of the skin while it is drying. If the skin is too hard and rough after drying, dampen it and work it again. Any residue of grease can be removed with gasoline. Finally, work the skin in dry hardwood sawdust to give the fur a luster.

**The salt-alum process** calls for 1 pound of ammonium aluminum sulfate or potassium aluminum sulfate dissolved in 1 gallon of cold water. Place 4 ounces of crystallized sodium carbonate (washing soda) and 8 ounces of common salt in  $\frac{1}{2}$  gallon of cold water. Slowly pour the soda-salt solution **into** the alum solution while stirring vigorously. Next mix the combined solutions with enough flour to make a thin paste. Wet the flour with a little water to prevent lumping.

The rabbit skin should be clean and soft before this paste is applied. Tack the skin smoothly, flesh side up, on a board. Apply to it a  $\frac{1}{8}$ -inch coat of the tanning paste and, as in the salt-acid process, lightly cover the paste with paper or burlap to prevent rapid drying. The next day scrape off most of the paste and apply a

second  $\frac{1}{8}$ -inch coat, as before, again covering to prevent drying out.

Repeat this process 2 or 3 times, depending on the thickness of the skin. The thick skin of a buck may require 3 treatments, but 2 treatments should be sufficient for the thin skin of a young rabbit. Leave the last paste coating on for 3 or 4 days, then remove it by scraping. Now work the skin in borax water (1 ounce of borax to 1 gallon of water), rinse, and gently squeeze out the water. Work the skin by stretching and pulling as described for the other process, and finally work it in dry hardwood sawdust for luster.

### **Use of Furs**

It is not possible in this circular to describe the manufacture of fur garments from tanned rabbit pelts. The producer will nevertheless need to know something about the use of furs.

Rabbit furs have been sold under various trade names: lapin, galapin, sealine, beaverette, and moline. Lapin is very popular. The fur is dyed tan, beige, gray, beaver, brown, dark brown, and costume colors, or it is stenciled in imitation of leopard. Galapin is a term applied to black lapin. Sealine is imitation seal; beaverette, imitation beaver; and moline, imitation mole.

Skill in fur-garment manufacture is due to years of experience by the established furrier and to the mechanism of the fur-sewing machine which sews patches invisible from the outside. A person who does not have special machinery should not attempt the manufacture of fur garments. The result will always show lack of skill.

### **Wool**

Angora rabbit wool is usually clipped once every 3 months. It grows about an inch a month. Mills normally prefer wool  $2\frac{1}{2}$  to 3 inches long, not longer. The first clip is made when the young are about 3

months old. This amounts to approximately 1 ounce. If the wool is badly matted it should be clipped and destroyed.

Angora wool is used in the manufacture of yarn for sportswear, such as sweaters

and scarfs, is woven into fabrics and sold as bunny cloth, or is spun with wool and sold as Angora knit. Dealers call these various products "rabbit's hair cloth" or

"rabbit's hair fabrics," but in all instances Angora rabbit wool is utilized, not ordinary rabbit hair. Some fabrics are manufactured in Europe and exported.

## MARKETING MEAT, PELTS AND FURS, AND WOOL

### Meat

**Live Rabbits.** Most of the live rabbits marketed in this state are collected by trucks sent out weekly or twice a month from large killing establishments. The high express rate on live meat rabbits, which is almost double that on live poultry, makes shipping by express rather expensive. Organized rabbit raisers have tried to have the commodity rate applied to live meat rabbits, as it is to live poultry, but the decision was against lowering the present rate. The lowest rate may be secured by keeping the valuation down on the shipment.

**Dressed Rabbits.** Many rabbit raisers do their own killing, but sell on a basis of live weight. Home dressing of rabbits will usually bring the producer somewhat greater profit than marketing alive. The producer who does his own killing and dressing is in a position to guarantee his product. However, it should be remembered that only a very small and unstable industry can be built upon direct and independent marketing.

Commercial rabbit butchers must satisfy all sanitation and health regulations of the state and county.

### Pelts and Furs

Marketing pelts and furs does not mean so much the selling of a few for special orders at a fancy price. It is the collection and sale of pelts in lots of a thousand at a time. New York buyers of Pacific Coast furs are the most reliable. Buyers in St. Louis, Chicago, and the Pacific Northwest are also active. Fur-buying companies have been formed in both central and southern California. Agents of these local companies, as well as of eastern companies, take practically all of the marketable pelts. The commission for selling furs is usually 10 per cent of the gross sales. The cost of shipping is extra.

Local buyers are inclined to have fewer grades of pelts than large eastern buyers, and naturally the local price must be enough less to cover the cost of grading and shipping to the eastern markets.

A few furs are being used in California, especially by some of the larger firms that can afford to employ a furrier. California rabbit producers need a fur-cutting company to buy hatters' pelts for the manufacture of hatters' fur. This would save needless expense in shipping hatters' pelts long distances. The outlook in California is for an increasing interest in rabbit furs by local manufacturers.

### Wool

Some American dealers handling rabbit pelts also take Angora rabbit wool. Moreover, the Federation of American Angora Breeders and the American Angora Rabbit Breeders' Coöperative market this wool for their members.

Early in 1940 the American Angora Rabbit Breeders' Coöperative informed

its members that since the market for Angora rabbit wool is seasonal, the wool must be stored during off seasons. As soon as a member sends his wool to coöperative headquarters, the wool is graded, and he receives a cash advance. Wool that is placed in a bonded warehouse where it is insured against all possible losses is

security for advances, but final payments await the sale of the wool delivered. The same coöperative has a mill where rabbit wool is used with sheep wool to

produce various kinds of yarn and cloth.

Angora wool can also be made into yarn at a mill and sold direct to department stores.

## BUSINESS ASPECTS OF THE INDUSTRY

### Costs

To secure a fair return on his investment, an operator must know what is considered a reasonable cost for each item of operation. He must also know the relation between the different items involved. Then, to be able to use this information, he must keep accurate records.

**Average Investment per Doe.** The Enterprise-Management studies found that rabbits require a greater investment per dollar gross income than poultry. Compared with poultry, they require a smaller percentage of the total investment in land, about the same in buildings, less in equipment, and more in stock. Feed and land costs are usually greater near the large cities, although they are offset, in part, by a better market if direct marketing is feasible.

Land, buildings, equipment, supplies on hand, and rabbit stock were valued at \$32.00 per doe in the Southern California Rabbit Management Study for 1947.

**Housing and Housing Equipment.** These costs vary too greatly to furnish accurate figures. Materials and labor for some of the modern 4- to 6-compartment hutches cost from \$16.00 to \$20.00. The housing and equipment charge in southern California for 1947 was 49 cents per doe.

**Labor.** Increased efficiency in the use of labor has not been sufficient to overcome the increased hourly labor cost—from 28 cents in the 1930–1939 period to 77 cents in 1946, 76 cents in 1947, and 84 cents in 1948. The total annual labor cost per doe increased from \$4.49 in the 1930–1939 period to \$9.11 in 1946, \$10.13 in 1947, and dropped to \$8.50 in 1948. A reasonable figure under recent price conditions is about \$10.00 per doe.

In terms of farm income—total earn-

ings from management, labor, and invested capital—\$9.83 for 13.2 hours of labor per doe in 1947 represents an average of about 74 cents an hour. Whether or not a producer would consider an hourly wage of 74 cents a reasonable rate of pay is a personal matter. In 1948 the farm income of \$10.39 for 10.1 hours of labor represented about \$1.02 per hour.

**Feed.** In the Southern California Management Study the annual feed cost per rabbit sold in 1947 was 75 cents, and the cost of feed per doe and her yearly increase of young (23.5) for this period was \$17.34. In 1948 the feed cost per doe was \$17.80. These figures include the cost of feed until the young were about 2 months old. Since each doe averaged 100.2 pounds of rabbit produced in 1947 and 92.2 pounds in 1948, the average feed cost per pound of rabbit raised can be figured at about 17 cents for 1947 and 19 cents for 1948.

Feed prices vary from year to year, but the Southern California Rabbit Management studies gave the following averages: Feed cost for 1947 per hundredweight (this included an average of 83 per cent pellets) was \$3.66; pellet feed cost per hundredweight was \$3.83. Feed cost for 1948 per hundredweight was \$4.07; grain per hundredweight was \$3.34; pellet per hundredweight was \$4.10; and hay per hundredweight was \$3.32.

Some rabbit raisers feeding only pellets had a moderate total feed cost per doe, but the majority of producers, even in the most profitable group, used some supplemental feed.

**Miscellaneous Expenses.** In addition to the cost of feed, labor, and rabbits bought, there has been a slight expense

for such items as taxes and water. The miscellaneous expenses per doe averaged 78 cents in 1947 and 56 cents in 1948 for the Southern California Enterprise-Management studies.

### **Per Pound Income Sources**

**Meat.** The total expense per doe, including feed, labor, rabbits bought, miscellaneous, depreciation, and interest at 5 per cent, was given in the Southern California Rabbit Management studies. This amounted to \$31.09 in 1947 for an average of 100.2 pounds of meat, live-weight basis, or about 31 cents a pound; and to \$29.68 in 1948 for an average of 92.2 pounds of meat, live-weight basis, or about 32 cents a pound.

Through greater production efficiency the net farm income per doe has increased from \$2.72 in the 1930-1939 period to \$13.52 in 1945; \$10.44 in 1946; \$9.83 in 1947; and \$10.39 in 1948.

In Los Angeles County, where the 1930-1939 average was recorded, production efficiency was not sufficiently great in 1947 to overcome the higher cost of feed, labor, and miscellaneous items, so there was a management loss compared with 1946. However, in 1948 the management income per doe was \$1.27.

**Meat.** Since 1930 there have been compiled 183 annual records, most of which were on meat rabbitries. Table 7 presents a general summary on meat rabbit production. It shows that the average price for fryers sold was only 12.7 cents, wholesale, live-weight basis, in the 1930-1939 period in Los Angeles County, but rose to 26.8 cents in 1945; to 27.4 cents in 1946; 27.4 cents in 1947; 31.2 cents in 1948; and 32 to 33 cents in early 1949. Live-weight prices dropped from 10 to 15 per cent late in 1949, with 22 to 23 cents being a common quotation. The figures for the different years given in this column were compiled from records of southern California coöoperators.

**Pelts and Furs.** The income for pelts and furs per doe in the 1948 Southern California Rabbit Management Study was so low that no cost per pound can be given for pelts and furs. Practically no rabbit pelts were sold; instead, the rabbits were sold alive.

**Wool.** The average cost per pound of wool for the 5 rabbitries recorded in the Enterprise-Management studies in 1937 was \$4.63 and in 1938, \$4.57. Considering feed alone, the average cost per pound of wool was \$1.92 in 1937 and \$2.10 in 1938.

The income for wool per doe in the 1948 Southern California Rabbit Management Study was so low that no cost per pound can be given for that year.

### **Returns**

**Pelts and Fur.** The records in the Southern California Rabbit Management studies show that the pelts of fryer rabbits net very little—approximately 18 to 20 cents each. Since most of the fryers and old breeding stock sold for meat are sold alive, the operator receives little income from fur or pelts. If a fryer sells at the average market price of approximately \$1.18, a value of about \$1.00 for meat and 18 cents for pelt might be allowed.

White butcher-run pelts have brought only about 75 to 85 cents a pound up to \$1.00 to \$1.20 a pound (5 to 7 large-sized pelts to the pound) in recent years. Hatters' pelts, which are lower in grade than butcher-run, were listed at 50 to 60 cents a pound in March, 1949.

**Note:** Prices for pelts dropped severely late in 1949—even below depression prices of the early 1930's. Prices mentioned here are from 3 to 5 times higher than those prevailing late in 1949.

The furs from carefully bred rabbits, on the other hand, may occasionally be valued at more than \$1.00 each, but there are not accurate figures to show how many prime pelts are sold by commercial producers in California, and any value given for such pelts would be only a guess.

**Wool.** In 1948, No. 1 grade Angora wool brought \$7.50 to \$9.00 a pound when a market was found, but feed prices also averaged close to \$5.00 per hundred pounds compared with about \$2.00 per hundred pounds before World War II, so

net profit to the grower did not increase in proportion to feed prices.

Table 8 gives a general summary of wool rabbit enterprises in Los Angeles County. Total income per doe is \$8.90; total expense per doe is \$5.54.

**Table 7. GENERAL SUMMARY MEAT RABBIT ENTERPRISES, SOUTHERN CALIFORNIA COUNTIES, FOR THE YEARS 1946 TO 1948 AND 1930 TO 1939**

	Three-year average 1946-1948	Ten-year average 1930-1939
Number of records, average annually.....	21	9
Average number of does per rabbitry.....	122	67
Number of kindlings per doe.....	3.9	3.2
Net number of rabbits raised per doe (yearly).....	23.0	16.7
Average weight per rabbit raised (pounds).....	4.5	3.9
Pounds of live rabbit produced per doe.....	101.4	65.0
Per cent mortality, does and breeding stock.....	36.2%	19.1%
Per cent mortality, young of number kindled.....	23.3%	23.0%
Average price per pound of fryers sold.....	29.4c	12.7c
Average value per pound all rabbits produced.....	28.9c	14.0c
Net cost of production per pound.....	28.6c	18.0c
Management income per pound produced.....	.3c	-4.0c
Pounds of feed (pellet basis) per pound produced.....	4.7	6.2
Price of pellets per hundredweight.....	\$4.00	\$1.83
Hours of labor per doe, operator and hired.....	12.3	16
Value per hour of labor.....	\$0.78	\$0.28
Feed costs per doe.....	\$18.52	\$5.83
Labor costs or value per doe.....	9.57	4.49
Miscellaneous costs, water, taxes, repairs, etc.....	.77	.47
Depreciation on buildings and equipment.....	1.05	.51
Interest on investment at 5%.....	1.12	.79
Total expense of production.....	\$31.03	\$12.09
Miscellaneous income, sacks of manure, etc.....	\$ .92	\$ .52
Value of net rabbit production per doe, including pelts.....	30.47	9.06
Total income.....	\$31.39	\$ 9.58
Management income per doe.....	\$ .36	\$ -2.51
Operator's net farm income per doe from value of labor, interest on investment, and management.....	\$10.79	\$ 2.72

**Breeding Stock.** Breeding stock usually brings much more per pound than fryer rabbits. In 1948, rabbitries in the Southern California Rabbit Management Study reported values per pound ranging from a minimum of 40.4 cents to a maximum of 82.4 cents and an average of 52.5 cents a pound. Pedigreed mature rabbits often bring \$10.00 or more in sale; the average given above, however, is somewhat less.

**Manure, Biological Specimens.** No

separate figures for the value of rabbit manure are available. In 1948, the value averaged only \$1.27 per doe. Few producers report any great sale.

A few rabbits have been sold for biological specimens at prices ranging from \$1.00 to \$1.25 or more each, at 4 pounds live weight. Rabbits used for pregnancy tests usually bring no more than normal meat prices; such sales therefore cannot be safely figured for more than the going rate for meat rabbits.

**Table 8. GENERAL SUMMARY WOOL RABBIT ENTERPRISES, LOS ANGELES COUNTY**

	Three-year average 1937-1939
Average number of records annually . . . . .	5
Average number of breeding does per rabbitry . . . . .	103
Average pounds of wool produced per doe . . . . .	1.2
Per cent of wool of No. 1 grade . . . . .	59%
Pounds of grain and pellets fed per doe . . . . .	129.6
Average feed cost per hundredweight, grain and pellets . . . . .	\$1.87
Hours of labor per doe . . . . .	10
Average price per pound, all wool . . . . .	\$3.32
 <b>Income per doe</b>	
Rabbits sold for meat . . . . .	\$ .79
Breeding stock sold . . . . .	3.01
Pelts and wool . . . . .	3.85
Miscellaneous, sacks of manure . . . . .	.12
Increase in rabbit inventory . . . . .	1.13
Total income per doe . . . . .	<hr/> \$8.90
 <b>Expenses per doe</b>	
Feed cost per doe . . . . .	\$2.44
Total value of operator and hired labor per doe . . . . .	2.55
Miscellaneous expenses . . . . .	.15
Depreciation on buildings and equipment . . . . .	.26
Interest on investment . . . . .	.41
Breeding stock bought . . . . .	.03
Total expense per doe . . . . .	<hr/> \$5.54
 <b>Management income per doe . . . . .</b>	
Operator's net farm income per doe from management, labor, and interest on investment* . . . . .	\$3.36
	\$5.82

\* For the same three years, farm income on 3 meat rabbitries averaged \$2.87 per doe.

**Table 9. A STANDARD OF CAPITAL INVESTMENT AND COSTS WITH INCOME FROM A WELL-MANAGED 250-DOE RABBITRY\***  
**(Production at the rate of 23.5 young or 105.8 pounds of fryer rabbits per doe)**

Capital investment	Original cost	Average value	Interest at 5 per cent	Depreciation	For 250 does	Per doe	Per pound, in cents
	In dollars per doe						
Land	\$ 3.00	\$ 3.00	\$ 0.15	\$ 1.20	.....	.....	.....
Buildings and equipment	20.00	10.00	0.50	.....	.....	.....	.....
Feed and supplies	1.00	1.00	0.05	.....	.....	.....	.....
Rabbit stock	8.00	8.00	0.40	.....	.....	.....	.....
Total	\$32.00	\$22.00	.....	\$ 1.20	\$300.00	\$ 1.20	1.1
Total depreciation	.....	.....	\$ 1.10	.....	275.00	1.10	1.1
Total interest on investment	.....	.....	.....	.....	.....	.....	.....
Total annual depreciation and interest	.....	.....	.....	.....	\$575.00	\$ 2.30	2.2
Other annual costs (feed, labor, etc., from table)	.....	.....	.....	.....	\$6,767.00	\$27.07	25.6
Grand total annual costs	.....	.....	.....	.....	\$7,342.00	\$29.37	27.8
Assumed income from 26,450 pounds at 29 cents per pound	.....	.....	.....	.....	7,670.50	30.68	29.0
Management income†	.....	.....	.....	.....	\$ 328.50	\$ 1.31	1.2
Farm income‡	.....	.....	.....	.....	2,793.50	11.17	10.6

\* Derived from table 8, Southern California Rabbit Management Study, 1947.

† Management income is total income less all costs, including the value of the operator's labor and 5 per cent interest on the investment.

‡ Farm income is defined as labor and interest plus management income. In this case, labor, \$2,180.00; interest, \$275.00; management, \$328.50.

## Records of Operation

Very few rabbit raisers really know if they are making a profit. A well-kept record book will indicate this at any time. This book should hold records of litters, breeding rabbits, receipts, and expenses.

**Pedigree Blanks.** Official pedigree blanks and hutch record cards can be secured from most rabbit-supply houses. Pedigree blanks, which come in pad form, have spaces in which to record the ancestry of a rabbit back to the great grand-sires and great granddams. There are also spaces for date of sale, name of breeder, registry number of each rabbit recorded, and the color. The weight of the rabbit, its name, weight of sire, weight of dam, disqualifications, if any, date of breeding, animal to which bred, and number of the pedigree blank are important items on the pedigree. The name and address of the breeder should also be affixed to this blank. A duplicate of the pedigree should be kept when a sale is made.

**Hutch Records.** Keep hutch records in duplicate. Fasten the original record card on the outside of the hutch door so that it will not be eaten by the rabbits. A

hutch record, such as that shown on page 64, has spaces in which to write the time of breeding, time of kindling, number in the litter, deaths, and any other necessary information on the rabbit.

**Ledgers.** Simple debit and credit ledgers are available at any bookstore. On the debit side show the amount and cost of feed used, rabbits purchased, improvements, bills payable, and other items of expense. On the credit side show number of pounds of meat sold and price; number and quality of pelts and furs sold and price; number of pounds of wool sold and price; breeding stock sold and price; and miscellaneous rabbit products and price.

**Inventory.** Take an inventory of stock and equipment during the slack months. The inventory should show the value of permanent improvements and fixtures, real estate involved, equipment, livestock, and products on hand. If improvements are necessary, the producer must first know where he is inefficient, and he cannot know this without a record of his operations.

## STANDARD OF EFFICIENCY

A plan of production is dependent on the goal. The possibilities of success are dependent on the costs of land and equipment, breeding stock, feed, and mortality, in relation to returns from the sources of income—meat, pelts and furs, wool, breeding stock, and miscellaneous items, such as manure and sale of rabbits to biological laboratories, plus the very important factor of dependable markets and the somewhat less important factor of favorable weather.

What the average net farm income may be over a period of years or for any one producer is a variable figure. An analysis of the records shows certain standards of attainment accomplished for separate items, but no one producer has attained a total standard of efficiency.

There has been a decided increase in efficiency in recent years, especially in the annual number of pounds of meat rabbits raised per doe, although mortality for mature does is still high. With figures based on the Southern California Rabbit Management Study for 1947, certain conclusions may be drawn.

**Minimum Goal.** About 250 does are considered the minimum goal for a full-time one-man business. A rabbitry of this size would call for an average investment of \$5,500. An operator working 8 hours a day for 365 days—spending 2,920 hours yearly in management—would net a farm income of about \$2,793 if fryer rabbits sold at an average of 29 cents a pound. Other producers, working under different conditions, should figure their farm in-

**Table 10. A STANDARD OF ANNUAL COSTS (OTHER THAN CAPITAL INVESTMENT, INTEREST, DEPRECIATION, AND MANAGEMENT)  
OF A WELL-MANAGED 250-DOE RABBITRY\***  
**(Production at the rate of 23.5 young or 105.8 pounds of fryer rabbits per doe)**

Cost items	Total per 250 does (pounds)	Per doe (pounds)	Per pound of rabbit (pounds)	Unit price per pound	Cost for 250 does	Cost per doe	Cost per pound (in cents)
<b>Feed in pounds:</b>							
Grain.....	10,850	43	0.41	\$ 4.00	\$ 434.00	\$ 1.74	1.6
Supplement (protein) .....	1,050	4	0.04	8.00	84.00	0.34	0.3
Pellets .....	80,675	323	3.05	4.00	3,227.00	12.91	12.2
Hay .....	33,850	135	1.28	2.00	677.00	2.70	2.6
Salt and minerals.....	.....	0.5	.....	.....	5.00	0.02	....
Total feed.....	.....	.....	4.6 pellets	.....	.....	.....	.....
Labor in hours.....	2,920	11.7	0.1	0.75	\$2,190.00	\$8.76	8.3
Miscellaneous expenses, taxes, water, etc. ....	.....	.....	.....	.....	150.00	0.60	0.6
<b>Grand total.....</b>	.....	.....	.....	.....	\$6,767.00	\$27.07	25.6

\* Derived from table 8, Southern California Rabbit Management Study, 1947.

come according to existing prices. The investment per doe in 1947, considered standard for a new enterprise, was \$32.00 (see table 9).

The range in number of pounds of live fryer rabbits produced per doe has varied considerably. This is due, in part, to the difference in number of litters per year and in mortality. With an average of 7.5 young per litter, and 4 litters a year, a doe may produce 30 young a year; but with 20 per cent mortality among the young, the net number raised is estimated at about 23.5.

In actual practice, it takes about 1.2 breeding animals for replacement. This leaves about 22.3 salable fryers per breeding doe. The average in 1947 was 21.1 fryers, 0.7 old rabbit, 0.2 breeding rabbit, or a total of 22.0 rabbits sold per doe. There was an increased inventory of 0.7 rabbit per doe, less 0.6 rabbit bought, or 0.1 additional rabbit per doe, making a total of 22.1 rabbits raised per doe.

The more profitable group of 13 producers in the Southern California Rabbit Management Study for 1947 had a net production of 23.8 rabbits raised per doe. There should always be a sufficient number of young breeding animals coming along to replace the nonbreeders and poor producers, which must be culled. Management of this kind is what is meant by having a goal. Data in tables 9 and 10 will help the producer to estimate returns in the future. Changing prices may be substituted for those given.

**Study of the Unit.** It is a good thing for an operator to study his unit for more profitable use of any spare time. In some instances, it may be best to discontinue the raising of rabbits. If an increase in the size of the rabbitry is indicated, certain marketing problems will have to be handled. Greater emphasis may be needed on any one, or two or more, of the sources of income.

With all of these possible sources of income put into effect, the average labor income may be considerably increased. There was an increase from 28 cents in the 1930-1939 period to 76 cents in 1947; and a further increase may be possible.

**Financial Reserves.** It is essential to attempt to build financial reserves in years of low prices. These will enable an operator to tide over until prices improve. There are always some producers who make more than the average return, because of low feed cost or good management, or both; and there are also producers who make only a small labor income or possibly barely meet the cash outlay. At least a fair return is essential or the business will suffer. Whether the business is a success or a failure is decided by the combined income from meat, pelts and furs, wool, breeding stock, and such miscellaneous sources as manure and sale to biological laboratories, less the cash costs, interest, and depreciation charges.

**UNIVERSITY OF CALIFORNIA**  
**COLLEGE OF AGRICULTURE**

**RABBIT HUTCH RECORD**

Hutch no.....

Name.....

Ear No.....

Registry No.....

Breed.....

Sex.....

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Variety.....

Born.....

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Served by.....

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Date served.....

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Date tested.....

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Date kindled.....

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Date weaned.....

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Number kindled.....

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Number left.....

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Number weaned.....

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Form A.—Hutch record card.

Fig. 25. Sample of hutch record used at College of Agriculture at Davis.

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J. Earl Coke, Director, California Agricultural Extension Service.

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